STAR

JUNE 8, 1969

VOLUME 7 • NUMBER 11

N69-21951—N69-23350

DOCUMENTS

JUN 1 3 1969

Duke University Library

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., 20402, United States of America.

Semimonthly issues...

Annual subscription rate: $54, domestic; $68.25, foreign. Price per single copy: $2.25, domestic; 25% extra for foreign mailing.

Cumulative index issues...

Annual subscription rate: $30, domestic; $35, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates...

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates...

Apply to Argentina, Brazil, French Guiana, Guyana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

Scientific and Technical Aerospace Reports, Volume 7, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by the Technical Information Services Company.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Introduction

WHAT *STAR* IS

Scientific and Technical Aerospace Reports (STAR) **is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published on the 8th and 23rd of each month.**

The following publications are abstracted in *STAR*:

Scientific and technical reports of the National Aeronautics and Space Administration and its contractors; scientific and technical reports of government agencies, universities, and research organizations throughout the world.

HOW *STAR* IS ORGANIZED

The first section of *STAR* contains citations and abstracts arranged in 34 subject categories. Following are six indexes: subject, personal author, corporate source, contract number, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, the fourth quarterly being an annual index for the calendar year.

HOW TO USE *STAR*

Readers are encouraged to examine abstracts in each subject category of interest. If time is short, readers may wish to scan the subject index for items of interest in a specific area. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject index in the cumulative indexes.

AVAILABILITY OF *STAR*

STAR **is available to the public on subscription from the Superintendent of Documents, U.S. Government Printing Office as noted on the inside cover. *STAR* is also available without charge to the following:**

1. **NASA Offices, Centers, contractors, subcontractors, grantees, and consultants;**
2. **Other U.S. Government agencies and their contractors;**
3. **Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public use;**
4. **Other organizations in the United States having a need for NASA documents in work related to the aerospace program; and**
5. **Foreign government or academic organizations that have established appropriate reciprocal arrangements with NASA.**

AVAILABILITY OF DOCUMENTS

All documents announced in *STAR* are available to the public as indicated in the citation.

AVAILABILITY OF NASA DOCUMENTS

NASA documents are identified by an asterisk in the abstract section and in the report/accession number and accession/report number indexes. NASA documents that have been microfiched[1] (identified by the # sign in citation) are available on microfiche without charge to an organization eligible to receive *STAR*. Selected NASA documents are formally printed and are available without charge in printed form on initial distribution to the organizations eligible to receive *STAR*.

(1) A microfiche is a transparent sheet of film, 105 X 148 mm in size, capable of containing up to 72 pages of information reduced to micro images (not to exceed 20:1 reduction).

AVAILABILITY OF NON-NASA DOCUMENTS

Non-NASA documents are those documents that do not carry an asterisk in the citation.

Department of Defense documents (identified by the "AD" number in the citation and indexes) are available, subject to a service charge, in hard copy or microfiche from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Microfiche copy of DOD reports will continue to be available to Defense Documentation Center users at no cost from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

National Lending Library (NLL) for Science and Technology translations are available from NLL at the price stipulated in the citation. Requests for purchase should be addressed to:

National Lending Library for Science and Technology
Boston Spa, Yorkshire, England.

Dissertations selected from *Dissertation Abstracts* are available in xerographic copy (HC) and on microfilm for sale from University Microfilms, Inc., Ann Arbor, Michigan, 48106. All requests should cite the author and Order Number as they appear in the citation. Note that the dissertations are provided on microfilm and not microfiche.

Other non-NASA documents are publicly available as indicated in the citation. Those documents which have been microfiched are available on microfiche without charge only to NASA Offices, Centers, contractors, subcontractors, and consultants.

HOW TO OBTAIN MICROFICHE

If you are registered with NASA and eligible to receive reports as described above, send the completed *Document Request* (Facility Form 492) to:

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

If you are not registered with NASA and wish to receive information concerning registration, request *Registration Form—Technical Publications* (Facility Form 713) from the NASA Scientific and Technical Information Facility at the address given above. Others may obtain microfiche copies by purchase from:

Clearinghouse for Federal Scientific and Technical Information
(CFSTI)
Springfield, Virginia 22151

U.S. GOVERNMENT SALES AGENCIES

Publications with a CFSTI availability statement in the citation are sold in hard copy and microfiche copy by:

Clearinghouse for Federal Scientific and Technical Information
(CFSTI)
Springfield, Virginia 22151

The following unit price has been established by CFSTI: $3.00 for hard copy, $0.65 for microfiche.

Publications with a SOD availability statement in the citation are sold in hard copy by:

Superintendent of Documents, U.S. Government Printing Office (SOD)
Washington, D.C. 20402

NASA documents available from the SOD are also available from CFSTI at the SOD price given in the citation.

NOTE: Documents announced without specific availability statement may be requested from the issuing activity.

Bibliographic information, e.g., report number, etc., rather than the NASA accession number (i.e., N69-12345), should be provided when requesting a document from other than NASA.

COSATI SUBJECT CATEGORY CODE

In the citation of each NASA-supported document and of some non-NASA documents is a code, e.g., CSCL 25A, that indicates the subject category assigned to it from the COSATI Subject Category List (first ed. December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

ABSTRACTS OF JOURNAL ARTICLES

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA*'s worldwide coverage of books and journals complements *STAR*'s worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code USI, Washington, D. C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

Annual subscription rates for *IAA*:

Semimonthly issues: United States and possessions, $54 postpaid; foreign countries, $68.25 postpaid.

Cumulated Index Volumes: United States and possessions, $30 postpaid; foreign countries, $35 postpaid.

INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U.S. Government Printing Office at $8.50 for the three-volume set.

EUROPEAN AVAILABILITY OF NASA DOCUMENTS

European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from:

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. de Neuilly
92-Neuilly-sur-Seine, France

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. They are identified by U.S. Patent No. and U.S. Patent Appl. Serial No. (SN) in the report/accession number index. The NASA Case number appears in lieu of the report number in the other indexes.

Copies of NASA patent application specifications are sold by the Clearinghouse for Federal Scientific and Technical Information at the established unit price of $3.00 for hard copy and $0.65 for microfiche. The NASA accession number should be used for ordering from CFSTI.

Printed copies of the NASA patents, when identified by the U.S. patent number, may be purchased for $0.50 each, postage free, from:

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

It is necessary that payment be remitted in advance, preferably by money order or check payable to the Commissioner of Patents. Prepaid purchase coupons for ordering are also available from the Patent Office.

Microfiche of NASA patents and patent application specifications are available from the NASA Scientific and Technical Information Facility without charge to registered requesters.

The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Assistant General Counsel for Patent Matters/Code GP-1
National Aeronautics and Space Administration
Washington, D.C. 20546

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **1801**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1803**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **1806**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **1808**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **1817**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **1819**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **1838**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **1845**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **1854**

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **1858**

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **1860**

12 FLUID MECHANICS
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **1864**

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **1870**

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **1882**

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. **1897**

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **1901**

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **1902**

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1909**

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **1911**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 1917

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 1922

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 1923

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 1937

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 1941

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 1978

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 1983

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 1988

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 1988

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 1989

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 1991

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2001**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2004**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2011**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **2014**

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-77

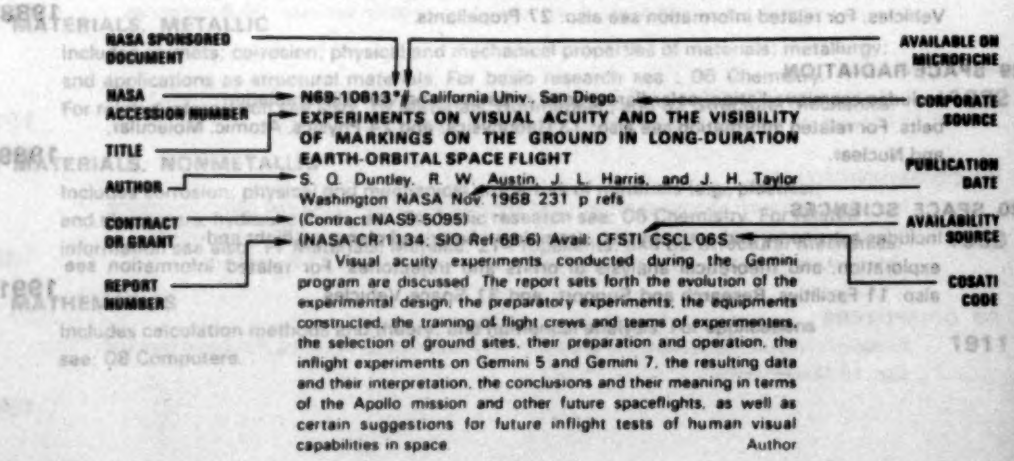
CORPORATE SOURCE INDEX I-111

CONTRACT NUMBER INDEX I-131

REPORT/ACCESSION NUMBER INDEX I-137

ACCESSION/REPORT NUMBER INDEX I-147

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N69-10813*# California Univ., San Diego
CORPORATE SOURCE
TITLE
EXPERIMENTS ON VISUAL ACUITY AND THE VISIBILITY OF MARKINGS ON THE GROUND IN LONG-DURATION EARTH-ORBITAL SPACE FLIGHT
AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
PUBLICATION DATE
Washington NASA Nov 1968 231 p refs
CONTRACT OR GRANT
(Contract NAS9-5095)
AVAILABILITY SOURCE
(NASA-CR-1134, SIO Ref 68-6) Avail: CFSTI CSCL 06S
REPORT NUMBER
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
COSATI CODE
Author

VOLUME 7, NUMBER 11 / JUNE 8, 1969

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N69-22086 North Carolina State Univ., Raleigh.
THEORETICAL INVESTIGATION OF LIQUID WATER INJECTION INTO THE SHOCK LAYER OF A REENTRY VEHICLE
Thomas Clay Dellinger (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-13474

An analysis is presented for the injection of a liquid spray into a supersonic air flow about a blunt body. The model employed assumes a two-phase flow with frozen chemistry and with simultaneous acceleration and evaporation of the spray. The effects of the injection speed, angle, drop size and mass flow rate are investigated, and the results are presented graphically. Greater penetration is obtained for the larger values of spray injection speed, angle and drop size; however, the mass flow rates investigated had little effect on the penetration. Initially, the spray acts to slow and to deflect the air stream with a subsequent rise in air temperature, but further downstream the effect of the spray diminishes and the air accelerates. The use of the results for assessing the effects of liquid injection on communications blackout is indicated. It is concluded that finite chemical reaction rates should be taken into consideration for more accurate flow-field calculations.
Dissert. Abstr.

N69-22174# Rensselaer Polytechnic Inst., Troy, N. Y.
EXPERIMENTAL STUDY OF THE EFFECT OF ORIFICE CONFIGURATION ON THE PERFORMANCE OF PERIPHERAL JETS
Tom G. Sandberg May 1968 34 p refs
(Grant NSF GK-618; Proj. Tubeflight)
(PB-180559; TR-PT-6802) Avail: CFSTI CSCL 13F

The report is concerned with the experimental investigation of the flow field beneath a two dimensional ground effect machine. Of particular interest were the relative effects of various exit configurations for the jet curtain on the flow field and performance of the ground effect machine. The three exit configurations studied were a straight continuous slot, a single row of holes, and a double row of holes. It was found that the slot gave the highest lift for a given jet curtain momentum flux, followed by the single row of holes, and the double row of holes proved to be the least efficient configuration tested. Lampblack patterns representing the flow fields under the various exit configurations are included among the figures.
Author (USGRDR)

N69-22186# Rensselaer Polytechnic Inst., Troy, N. Y.
RECIRCULATORY FLOW IN PERIPHERAL-JET SUPPORTS
Chen-C. Sun Jun. 1968 23 p refs
(Grant NSF GK-618; Proj. Tubeflight)
(PB-180560; TR-PT-6805) Avail: CFSTI 13F

A major object of the study is to derive a detailed analysis of the mixing process in a highly curved jet curtain, and hence to obtain a more accurate estimate of the loss of cushion pressure due to jet mixing. A second objective is to determine the extent to which the cushion pressure is affected by the nature of the recirculative flow within the cushion. The report presents preliminary attempts to establish a suitable mixing theory for the jet curtain.
Author (USGRDR)

N69-22211 State Univ. of New York at Buffalo.
ON THE RELATIONSHIP BETWEEN IMPELLER EXIT VELOCITY DISTRIBUTION AND BLADE CHANNEL FLOW IN A CENTRIFUGAL FAN
Ernest Bernhard Gardow (Ph.D. Thesis) 1968 299 p
Avail: Univ. Microfilms: HC $13.50/Microfilm $3.85 Order No. 68-11493

The air flow at the exit of the impeller of a high specific speed centrifugal fan of commercial design was investigated by studying measurements taken with a hot wire anemometer. Time average velocities and angles as well as instantaneous blade to blade values of these quantities were recorded as a function of distance across the impeller exit. An x-wire probe with a two-channel hot wire anemometer, along with appropriate recording equipment, was employed to obtain this information. The objective of the study was to deduce from the data what flow occurred in the impeller, and to predict what would take place in the housing, or diffuser. These deductions and postulates on what was occurring in the fan were compared to and correlated with the known overall performance for the fan.
Dissert. Abstr.

N69-22219# Sandia Corp., Albuquerque, N. Mex. Reentry and Space Sciences Div.
COMPUTER CODE HRS015: A QUIKTRAN COMPUTER CODE FOR THE COMPUTATION OF THE TRANSITION FLOW HYPERSONIC BALLISTIC COEFFICIENT OF A BLUNT OBJECT
H. R. Spahr Oct. 1968 50 p refs Sponsored by AEC
(SC-RR-68-529) Avail: CFSTI

In the Aerospace Nuclear Safety Program, safety analyses are required to determine the behavior of nuclear systems during launch aborts after liftoff and reentry after use in space. The required trajectories start at high altitudes where the reentering object is in the free molecule flow regime, subsequently pass through the transition flow regime, and terminate in the continuum flow regime. Thus, the hypersonic ballistic coefficient of the reentering object must be defined in the free molecule, transition, and continuum flow regimes. The QUIKTRAN computer code HRS015 developed by the Reentry and Space Sciences Division of

Sandia Laboratory's Aerospace Nuclear Safety Department is described. This computer code calculates the variation of the hypersonic ballistic coefficient of an object with altitude. Author (NSA)

N69-22220*# National Aeronautics and Space Administration, Washington, D. C.
RESEARCH ON LOW-DRAG TRANSONIC PROFILES [RECHERCHES SUR DES PROFILS TRANSSONIQUES DE FAIBLE TRAINEE]
Vincent de Paul Mar. 1969 33 p refs Transl. into ENGLISH from French Presented at the 4th Meeting of Appl. Dyn., Lille, 8–10 Nov. 1967
(NASA-TT-F-12171) Avail: CFSTI CSCL 01A

The results of work on the calculation and improvement of wing profiles in transonic flow are discussed in this article. A practical method of determining the drag rise Mach number (the Mach number at which point the drag begins to increase because of the shocks), based on the criterion of the "peak shock", is reviewed. The development of the supersonic zone is then analyzed by the method of characteristics for profiles which have an overspeed peak near the leading edge. It is shown how it is possible to obtain a profile giving supersonic recompression without shock, or at least ending with a weak shock, by local modifications of the upper sides. This method is illustrated by several examples. Author

N69-22501# Aeronautical Research Council (Gt. Brit.)
A GENERAL METHOD OF STUDYING STEADY LIFT INTERFERENCE IN SLOTTED AND PERFORATED TUNNELS
K. R. Rushton and Lucy M. Laing 1969 29 p refs Supersedes ARC-29237
(ARC-R/M-3567; ARC-29237) Copyright. Avail: CFSTI

A study of steady lift interference effects in wind tunnels with several different wall conditions has been carried out using a three-dimensional resistance network. The methods by which the various boundary conditions were simulated on the network are described in detail; conditions included closed, open, slotted and perforated walls. The evaluation of interference parameters is described, and for a completely closed tunnel these parameters are compared with analytical results. Numerous other examples of a rectangular wind tunnel have been studied and the resultant interference parameters are tabulated. Author (ESRO)

N69-22553*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REVISED FORTRAN PROGRAM FOR CALCULATING VELOCITIES AND STREAMLINES ON A BLADE TO BLADE STREAM SURFACE OF A TURBOMACHINE
Theodore Katsanis and William D. McNally Washington Apr. 1969 59 p refs
(NASA-TM-X-1764) Avail: CFSTI CSCL 01A

An existing FORTRAN IV computer program for blade-to-blade aerodynamic analysis of turbomachine blades was revised to obtain a simpler program consistent with related programs. The analysis is for two-dimensional, subsonic, compressible or incompressible, nonviscous flow in a circular or straight infinite cascade of blades, which may be fixed or rotating. The flow may be axial, radial, or mixed, and the stream channel thickness may change in the through-flow direction. The results include streamline coordinates, velocity magnitude and direction throughout the passage, and the blade-surface velocities. This report includes a complete description of the input required by the program and the program listing. Author

N69-22554*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL STAGNATION POINT VELOCITY GRADIENTS AND HEAT TRANSFER COEFFICIENTS FOR A FAMILY OF BLUNT BODIES AT MACH 8 AND ANGLES OF ATTACK
James C. Ellison Washington Apr. 1969 24 p refs
(NASA-TN-D-5121) Avail: CFSTI CSCL 01A

Local pressure and heat-transfer measurements were obtained on a family of blunt, axisymmetric bodies having a range of ratios of body radius to nose radius from 0 to 0.707, and ratios of corner radius to body radius of 0 to 0.40. The experimental data were obtained at a Mach number of 8.0 and a Reynolds number of 1.37 $\times$ 10^6, over a range of angles of attack from 0° to 20°. An effective nose radius was determined for each body and employed to calculate the stagnation-point values of the heat-transfer coefficient. The results indicated that the stagnation-point heat-transfer coefficient for a given body geometry varies with the angle of attack, except for the flat-faced body having the largest corner radius. Author

N69-22589# Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Dept.
FREE-FALL ROTATION AND AERODYNAMIC MOTION OF RECTANGULAR PLATES
A. C. Bustamante Aug. 1968 75 p refs Sponsored by AEC
(SC-RR-68-132) Avail: CFSTI

The aerodynamic motion of rectangular plates observed in 18 free-fall drop tests is analyzed and described. In most of the drops, the plates autorotated; the autorotation was independent of the plates' initial attitude. The autorotation generated a small lifting force which caused the plates to experience a gliding and spiraling motion. Author (NSA)

N69-22802# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERODYNAMIC CHARACTERISTICS OF A SPHERE AND BLUNT-NOSED CONE IN A HIGHLY RAREFIED GAS FLOW
V. A. Perepukhov Jun. 1968 20 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 2, 1967 p 444–452
(AD-681686; FTD-MT-24-135-68) Avail: CFSTI CSCL 20/4

An analytical method for determining the aerodynamic properties of a sphere and blunt-nosed cone in a highly rarefied gas flow is presented, taking account of interactions of rebounding molecules with those of the oncoming stream ahead of the body, moving at high supersonic speed. Expressions for the number of collisions at the point A are established for the cases of a sphere and a truncated cone. The effect of the mutual collisions of the emitted molecules on the aerodynamic characteristics and the effect of attenuation of the oncoming molecules on the rebounding flux are evaluated using the first-collision method. TAB

N69-22822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WIND TUNNEL INVESTIGATION OF THE FLOW FIELD UNDER A 60 DEGREE SWEPT WING AT MACH NUMBERS FROM 0.6 TO 2.6
Bernard J. Blaha Apr. 1969 46 p refs
(NASA-TM-X-52585) Avail: CFSTI CSCL 01A

Conical flow probes were utilized to survey the local flow under the wing of a 1:20 scale model of the F-106B aircraft. Local Mach number and flow angles were determined at locations where an inlet, designed for use on pod-mounted engines, might be positioned so as to use wing shielding to minimize angle of attack effects on inlet performance. Tests were conducted in 8 $\times$ 10 and

10 × 10 ft supersonic wind tunnels over a range in Mach number from 0.6 to 2.0 and at angles of attack from −5 to +19 deg. Author

N69-22925# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
NOISE STUDIES FROM THE FAN-IN-WING MODEL
G. Krishnappa Jun. 1968 19 p refs
(NRC-10605; LR-508) Avail: CFSTI

Measurements of the spectra are presented for fan speeds of 7500, 9750, and 13,125 rpm (corresponding to tip Mach number 0.35, 0.45, and 0.62) at an angle of 20° from the axis of the fan and at 5 feet from the inlet and efflux faces of the fan. The experimental results show a discrete peak at blade-passing frequency, superimposed on a broad band noise that extends from 1000 cs to 15,000 cs. An analysis of the duct transmission of higher order modes at the above rotational speeds reveals high decay rates. This explains the absence of discrete tones at the harmonics of the blade-passing frequencies. The presence of high intensity broad band noise may be attributed to the turbulence in the wake and free stream turbulence ahead of the rotor blades. Author

N69-22938*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FORTRAN PROGRAM FOR CALCULATING VELOCITIES IN A MAGNIFIED REGION ON A BLADE TO BLADE STREAM SURFACE OF A TURBOMACHINE
Theodore Katsanis and William D. McNally Washington Apr. 1969 83 p refs
(NASA-TN-D-5091) Avail: CFSTI CSCL 20D

A Fortran IV computer program was written to obtain a local detailed solution around a leading or trailing edge or in a slot region for compressible, subsonic, nonviscous flow on a blade-to-blade surface between turbomachine blades. This program allows a coarse-mesh solution for an entire blade-to-blade region to be magnified in a small rectangular region. The results include detailed surface velocities, velocity magnitude and direction, and stream-function values throughout the magnified region. The method is based on the stream function and uses the iterative solution of nonlinear finite-difference equations. Author

N69-23168# Aeronautical Research Labs., Melbourne (Australia).
A COMPARISON OF PRESSURE FIELDS GENERATED BY CONTINUOUS AND DISCONTINUOUS BODIES IN SUPERSONIC FLOW
L. E. Reece Aug. 1968 79 p refs
(ARL/A-131) Avail: CFSTI

The far field overpressure produced by shock waves originating from a body in supersonic flow is an unwanted concomitant of supersonic flight. This study investigates the effect of increasing the extent of the near field, within which the overpressure is lower and the possibility of favorable wave interaction to reduce far field overpressure. For comparison two dimensional and axially symmetric fields are studied. Within the near field the maximum overpressure is lower for the discontinuous body than for the simple body. The far field overpressures are identical within the assumptions which were made and within those imposed by the accuracy of the computation. The axially symmetric near field is from five to ten times more extensive than the equivalent two dimensional near field. Author

N69-23195*# Aztec School of Languages, Inc., Acton, Mass.
AERODYNAMIC CONSTRUCTION OF TRANSPORT AIRPLANE WINGS FOR CRUISING FLIGHT AT HIGH SUBSONIC SPEEDS[AERODYNAMISHE AUSLEGUND DER TRAGFLUEGEL VON TRANSPORTFLUGZEUGEN FUER DEN REISEFLUG BEI HOHEN UNTERSCHALLGE SCHWINDIGKEITEN]
H. Fridel et al Washington NASA Apr. 1969 59 p refs Transl. into ENGLISH from German Report DLR-67-24 Submitted for publication
(Contract NASw-1692)
(NASA-TT-F-12048; DLR-67-24) Avail: CFSTI CSCL 01A

Problems are dealt with which occur during aerodynamic design of lifting-wings of transport aircraft at in cruising flight at high subsonic velocities. In addition to fundamental questions of wing optimization, the problems connected with compressible resistance increase are explained. The relationships on the profile (two-dimensional case) and the relationship on the wing, especially on the arrow wing (three-dimensional case) are considered. After an explanation of the mathematical processes required for wing design, the procedure of wing geometry is outlined. Author

N69-23315# Aeronautical Research Council (Gt. Brit.)
COMPARATIVE THEORETICAL CALCULATIONS OF FORCES ON OSCILLATING WINGS THROUGH THE TRANSONIC SPEED RANGE
H. C. Garner and Doris E. Lehrian 1969 55 p refs Supersedes NPL-AERO-1248; ARC-29367; see N68-34258
(ARC-R/M-3559; NPL-AERO-1246; ARC-29367) Copyright. Avail: CFSTI

Numerous linearized theories are applied to plunging and pitching rectangular, delta and symmetrical tapered wings in subsonic, sonic and supersonic flow. Pitching moments are presented as continuous curves against Mach number for fixed frequency parameter. General theories are appraised beside exact theories for particular wings. Comparisons with experiment are satisfactory, except in transonic flow where uncertain wall interference masks the true discrepancies. Author (ESRO)

N69-23319# Aeronautical Research Council (Gt. Brit.)
A MOMENTUM ANALYSIS OF LIFTING SURFACES IN INVISCID SUPERSONIC FLOW
P. L. Roe 1969 39 p refs Supersedes RAE-TR-67124; ARC-29530
(ARC-R/M-3576; RAE-TR-67124; ARC-29530) Copyright. Avail: CFSTI

Momentum considerations are used to derive relationships between the lifting efficiency of a wing having an attached shock system and properties of the flow field around it. Optimum two-dimensional flow fields are derived using shock expansion theory. These may be used to design three-dimensional shapes having slightly greater lifting efficiencies than plane wedges. An analysis of the flow in any plane of symmetry is used to suggest desirable features of more general flow fields. Author (ESRO)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-22274# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugmechanik.
PROBLEMS OF PARACHUTE TECHNIQUE [PROBLEME DER FALLSCHIRMTECHNIK]
Nov. 1967 105 p refs In GERMAN; ENGLISH summary Proc. of the Inst. für Flugmech. Symp. on Parachute Tech., Brunswick, 15 Feb. 1967
(DLR-MITT-67-22) Avail: CFSTI

Symposium papers on parachute techniques with emphasis on stress distribution in the parachute canopy, stabilization problems, steerable parachutes, cloths, ribbons and cords for parachutes, measuring techniques, and parachutes and recovery systems in the supersonic range are presented. ESRO

N69-22285# Princeton Univ., N. J.
IMPROVING THE ACQUISITION PROCESS FOR HIGH RISK ELECTRONICS SYSTEMS
Richard A. Stubbing May 1968 45 p refs
(AD-681518) Avail: Issuing Activity CSCL 15/5

A sample of 13 major Air Force/Navy aircraft and missile programs with sophisticated electronic systems initiated since 1955 at a total cost of $40 billion, reveals that less than 40% of the effort produced systems with acceptable electronic performance -- an uninspiring record that loses further lustre when cost overruns and schedule delays are also evaluated. What course of action can be offered to improve electronic system performance in future new weapon systems. In an attempt to answer this question, this paper analyzes the characteristics and results of recent large scale electronic systems developed for missile and aircraft programs. Actual program histories are documented, alternative procedures involving non-competitive and competitive situations are compared, and specific proposals involving greater use of competitive contractor developments are advanced for all future complex electronics systems. Author (TAB)

N69-22511*# Techtran Corp., Glen Burnie, Md.
HUMAN PILOT AND AUTOMATIC SYSTEMS [PILOTE HUMAIN ET AUTOMATISMES]
R. Lami Washington NASA Dec. 1968 19 p Transl. into ENGLISH of French conf. paper Presented at the 8th Intern. Aeron. Congr., Paris, 29–31 May 1967
(Contract NASw-1695)
(NASA-TT-F-12307) Avail: CFSTI CSCL 01D

Discussion of the opinion of a pilot on the help which automatic systems might afford during instrument takeoff and landing. It is pointed out that automation is justified only to the extent that it makes it possible to reach a level of performance or safety which man cannot reach by any other means. Automatic landing often leads to long procedures because it is necessary to line up the aircraft at a considerable distance, whereas the procedure can often be made shorter by manual piloting. The consequences of the use of automatic systems for the development and training of pilots are discussed. Author

N69-22539*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE USE OF PILOT RATING IN THE EVALUATION OF AIRCRAFT HANDLING QUALITIES
George E. Cooper and Robert P. Harper, Jr. (Cornell Aeron. Lab.) Washington Apr. 1969 54 p refs
(NASA-TN-D-5153) Avail: CFSTI CSCL 01A

Pilot rating scales and their use in assessing aircraft handling qualities are reviewed historically, and objections that have been raised to limitations of earlier scales are considered in the development of a revised scale. Terminology used in the evaluation of handling qualities is reviewed and new definitions are proposed to improve communication and international understanding. Of particular significance is the new definition of handling qualities, which emphasizes the importance of factors that influence the selection of a rating other than stability and control characteristics. The experimental use of pilot rating is discussed in detail, with special attention devoted to (1) clarifying the difference between mission and task, (2) identifying what the rating applies to, (3) considering the pilot's assessment criteria, and (4) defining the simulation situation. The important elements of the report are then summarized in a suggested Briefing Guide, designed for guidance in planning and executing handling qualities experiments. Author (F.S.)

N69-22546*# Aeronautical Research Associates of Princeton, Inc., N. J.
SONIC BOOM PROPAGATION IN A STRATIFIED ATMOSPHERE, WITH COMPUTER PROGRAM
Wallace D. Hayes, Rudolph C. Haefeli, and H. E. Kulsrud Washington NASA Apr. 1969 50 p refs
(Contract NAS1-7721)
(NASA-CR-1299) Avail: CFSTI CSCL 20A

This analysis, to some extent a synthesis of established theory but with many new features, is given in sufficient detail to serve as an algorithm for the computation of sonic boom pressure signatures. This algorithm is realized in a FORTRAN computer program. Required inputs include atmospheric properties and horizontal winds as functions of altitude, information on the flight path of the maneuvering aircraft, and aircraft F-functions. Ray tube areas are computed according to geometric acoustic theory, and nonlinear effects are accounted for through an appropriate age variable. The output includes midfield pressure signatures at any altitude. Results from sample calculations are presented and discussed. Author

N69-22548# Advisory Group for Aerospace Research and Development, Paris (France).
THE ACV CONCEPT AND ITS MILITARY APPLICATION. PART 1: TEXT
1968 45 p
(AGARD-AR-15-Pt-1) Avail: CFSTI

A review is given of the principles and research background, the present state of the art and the experience that has been gained with air cushion vehicles. The future trends in development are predicted and military applications are outlined. Illustrations along with the text are given. Author

N69-22549# Advisory Group for Aerospace Research and Development, Paris (France).
THE ACV CONCEPT AND ITS MILITARY APPLICATION. PART 2: ILLUSTRATIONS
1968 32 p
(AGARD-AR-15-Pt-2) Avail: CFSTI

Illustrations of the various types of air cushion vehicles are given showing the different ways it can be used. Military applications of the air cushion vehicle are discussed. B. G. D.

N69-22672*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN INVESTIGATION OF A DIRECT SIDE-FORCE MANEUVERING SYSTEM ON A DEFLECTED JET VTOL AIRCRAFT
Terrell W. Feistel, Ronald M. Gerdes, and Emmett B. Fry Washington Apr. 1969 15 p refs
(NASA-TN-D-5175) Avail: CFSTI CSCL 01C

A series of flight and simulator tests were conducted using the X-14A variable stability jet VTOL research aircraft and an all-axis motion simulator to determine the acceptability of a direct side-force vane for sideward maneuvering without changing bank

angle. The side-force vane, immersed in the jet exhaust of the X-14A just below the diverters, deflected the jet sideways through a small angle and was controlled by a device on the pilot's control stick, which could provide either proportional or on-off control. The side-force vane with proportional control was evaluated in flight for the performance of lateral offset maneuvers of 1 to 2 wing spans translation distance. For this task, the use of the vane for translation was preferred over roll when only a low value of roll control power was available, with a higher control power available in roll; the two methods were equally acceptable. Author

N69-22844# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PARACHUTE TESTS IN THE MODANE LARGE SONIC WIND TUNNEL [ESSAIS DE PARACHUTES DANS LA GRANDE SOUFFLERIE SONIQUE DE MODANE-AVRIEUX]
Jacques Coste 1969 18 p refs in FRENCH; ENGLISH Summary
(ONERA-NT-141) Avail: CFSTI

The maximum diameter of the canopy in the S1 wind tunnel is about 3 meters; the maximum capacity of the drag dynamometer is 100,000 newton (about 10 tons); and the maximum wind tunnel speed is near Mach 1. For reduced scale tests, similarity conditions were particularly studied. From motion pictures it was possible to analyze the behavior of the various elements of the parachute and to calculate their trajectories as a function of time. Some numerical results are presented, and actual extracting mechanisms were used during the experiments. Author

N69-22849# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
AN INVESTIGATION OF IN-FLIGHT FIRE PROTECTION WITH A TURBOFAN POWERPLANT INSTALLATION Final Report
Eugene P. Klueg and James E. Demaree Apr. 1969 236 p refs
(NA-69-26; DS-68-26) Avail: Issuing Activity

The potential explosive, fire hazards, and methods of detecting and controlling in-flight fires on modern aircraft powerplant installations were investigated under full-scale simulated low altitude flight conditions. Modifications were made to the pod-mounted turbofan engine test article to extend the program scope beyond the normal range of variables present on the installation. The test program consisted of five studies: (1) environmental conditions producing thermal ignition of combustible mixtures and ignition characteristics, (2) characteristics of nacelle fires, (3) system performance and installation requirements for fire and overheat detection, (4) requirements for extinguishing and controlling fires, and (5) effects of fires and explosions on the powerplant installation. Author (BGD)

N69-22915# Air Registration Board, London (England).
CIVIL AIRCRAFT AIRWORTHINESS DATA RECORDING PROGRAMME: STALL MARGINS DURING THE TAKE-OFF MANOEUVRE
Sep. 1968 39 p refs
(ARB-TN-94; TR-9) Copyright. Avail: CFSTI

Analysis of the takeoff maneuver has been carried out for 500 cases using data for one aircraft. Statistical data on the maximum g increment used and available, and of the residual margin to the stall, are presented, and the effects of flap angle, aircraft weight and turbulence are investigated. The current requirements appear to result in satisfactory margins, at least for the range of operating conditions covered in the survey (European short-haul routes). Author

N69-22941# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Aeronautical Engineering and Astronautics.
PERIPHERAL JETS AND PLENUM CHAMBERS. AN EXACT POTENTIAL FLOW ANALYSIS
George C. Cooke, IV (Ph.D. Thesis) Nov. 1968 37 p refs
(Contract C-117-66)
(PB-180561; TR-AE6811) Avail: CFSTI CSCL 13F

The report presents the results of a potential flow study for air cushion devices in hovering. The emphasis is on the importance of pre-exit turning. In the analysis the flow issues from an infinite duct with parallel walls. The theory uses conformal transformations to relate the complex potential and the complex velocity. The resulting differential equation can then be integrated to give the flow velocity as a function of geometric coordinates. The applicability of the analysis is independent of ground clearance and hence provides a bridge between peripheral-jet and plenum theories. Results for the variation of base pressure, flow coefficient, discharge coefficient and the two components of jet reaction with ground clearance are presented for several duct angles. The effect of extending the outer lip is shown. The exit velocity profile and a streamline plot are presented for a vertical jet at a height-to-thickness ratio of 2. Author (USGRDR)

N69-23097# Royal Aircraft Establishment, Farnborough (England).
KLM STUDIES ON THE LANDING OF AIRCRAFT WITH LOW WEATHER MINIMA [KLM STUDIES BETREFFENDE DE LANDING VAN VLIEGTUIGEN BIJ LAGE WEERSLIMIETEN]
C. H. Reede Dec. 1968 31 p Transl. into ENGLISH from Ing. (The Hague), v. 77, no. 11, 1965 p L1–L13 Presented at the Meth. Aaron. Soc., Amsterdam, 18 Jun. 1964
(RAE-LIB-TRANS-1250) Avail: CFSTI

As part of their studies on means to achieve lower weather minima, KLM carried out a program of research into the feasibility and adequacy of giving the pilot of a large jet aircraft final approach and flare-out guidance by means of a head-up display driven by a flare-out computer. To obtain an insight into the way in which a pilot lands a large jet aircraft, a number of normal landings with a DC 8 were recorded. Results of this part of the program are given and tentative conclusions on the normal method of landing a DC 8 are drawn. These results are used to assess the acceptability to the pilot of the experimental flare-out guidance equipment installed and flight tested in the aircraft later, a PVD head-up display driven by a flare-out computer. The system is discussed and the method in which it was adjusted during a test flight is described. A few results of the very limited amount of experience with the system during line flights are given; these results appear promising. Author

N69-23237# Amglo Corp., Chicago, Ill.
APPROACH LIGHTING SYSTEM FLUSH FLASHER ASSEMBLIES Final Report
F. Chybik and R. A. Bamberger Jan. 1969 59 p refs
(Contract FA-67-WA-1738)
(SRDS-RD-69-3) Avail: Issuing Activity

The most optically complicated model is designated the 5858 system. It includes a 20-beam optical unit and a separately enclosed power supply. The other model, the 3051 system, has a 4-beam optical unit and a power supply identical to the one for the 5858 system. Each optical unit contains one helical flashtube that produces 3.78 candela-seconds per joule. The 5858 system was designed to produce a centerline effective intensity of not less than 10,000 candelas, and a minimum effective intensity of 8,000 candelas over a 15° × 30° rectangular pattern when flashed twice a second with a power input less than 1000 volt-amperes. The measured intensities on the model delivered to FAA were approximately one-half the required values. The 3051 system was designed to produce a minimum effective intensity of 5000

candelas over the specified pattern. The measured effective intensity is 6240 candelas. Author

N69-23300# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
A MANUALLY OPERATED TRACE READER AND DIGITAL ENCODER
S. G. Kerr Aug. 1968 22 p refs
(ARL/FL-42) Avail: CFSTI

A description is given of a manually operated machine which enables data from an eleven trace oscillographic record to be rapidly converted to digital form on punched paper tape. The oscillogram and editing procedure, data reading and encoding system, design features, and operation sequences are discussed. Operational performance is evaluated as to speed, errors, and reliability. Unserviceability was found to be small and could be made negligible by modifications. (P.A.B)

N69-23312# Aeronautical Research Council (Gt. Brit.)
THE SPEED RESPONSE OF AN AIRCRAFT CONSTRAINED TO FLY ALONG A STRAIGHT PATH IN THE PRESENCE OF TURBULENCE AT LOW ALTITUDE
J. G. Jones 1969 29 p refs Supersedes RAE-TR-67242; ARC-29912
(ARC-R/M-3563; RAE-TR-67242; ARC-29912) Copyright. Avail: CFSTI

Effects of speed stability and turbulence upon airspeed response of an aircraft flying under landing approach conditions are investigated by considering response to turbulence when the aircraft is constrained to fly along a straight path by means of the elevator. The speed-stable and speed-unstable cases are treated in a uniform manner by considering the way in which airspeed 'diffuses' from an initial known value, results being expressed in terms of the time variation of the probability distribution of airspeed error. Author (ESRO)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-22169*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL CADMIUM AEROSPACE CELLS Quarterly Report, 8 Aug.–7 Nov. 1968
Helen Feng, Robert A. Cattabriga, George F. Hurley, and John M. Parry Nov. 1968 27 p refs
(Contract NAS5-11561)
(NASA-CR-100554; QR-2) Avail: CFSTI CSCL 10C

This report describes the initial experiments carried out on the sintering of carbonyl nickel powders for the fabrication of porous nickel plaque for nickel cadmium battery plates. Emphasis was placed on loose sintering of the powders without a support screen to facilitate a detailed study of the sintering characteristics of the powder. The initial experiments involved the establishment of a flat temperature profile in the sintering zone of the furnace and optimization of mold design in order to form highly uniform plaques. The results relate to the effect of sintering time and sintering temperature on plaque characteristics. The plaques were characterized in terms of porosity, thickness, surface area, pore size distribution, electrical conductivity and mechanical strength. Detailed metallographic analysis was carried out on selected plaques. Author

N69-22171*# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
SOLAR CELL CONTACT DEVELOPMENT Quarterly Report, 28 Sep.–28 Dec. 1968
28 Dec. 1968 31 p refs
(Contract NAS5-11595)
(NASA-CR-100553; QR-2) Avail: CFSTI CSCL 10B

This report describes the technical work performed during the second quarter of a 12-month research contract to identify the Ti-Ag contact degradation mechanism on Si solar cells and to determine whether sputter deposition of contact material is compatible with present solar cell configurations. Results indicated that contact degradation occurs within the Ti-Ag contact and is most probably due to a chemical transformation of the highly reactive Ti metal to a stable compound of Ti. One of the objectives was to determine the reactivity of Ti to various gases and aqueous solutions when unprotected and when coated with an evaporated film of Ag. Gases included non-purified and purified Ar, wet Ar, wet and dry O_2, forming gas, and N_2. Aqueous solutions include NaOH, KOH, NaCl, and H_2O. Results of this work clearly show that diffusion of species through the Ag film does occur and results in the attack of the underlying Ti. Controlled environmental tests were also conducted on Si solar cells with the result that blistering was promoted. Author

N69-22175*# Radio Corp. of America, Princeton, N. J. Astro Electronics Div.
STUDY OF POWER SUPPLY CONFIGURATIONS FOR ADVANCED NIMBUS MISSIONS Final Report, 30 Apr. 1968–31 Jan. 1969
31 Jan. 1969 167 p refs
(Contract NAS5-11549)
(NASA-CR-100529; R-3431) Avail: CFSTI 10B

In this study, various solar power conversion subsystems are compared and analyzed for possible application in future Nimbus missions. Maximum use was made of existing flight-qualified Nimbus hardware and techniques to configure alternate power subsystems that will supply more load power. System configurations having a load capability range of 200 to 500 W, orbit average and at beginning of life, are considered. As much as 350 W can be obtained for the entire two-year mission with the parallel part-time/full-time tracker system configuration under nominal operating conditions. Higher power systems would utilize the bifold solar array already developed on the Nimbus project. A separate peak load converter/regulator is suggested for all systems. A severe limitation was found to exist with the series tracker configuration: an orbit average power dissipation of more than 50 W would exist in this unit, which practically precludes its use in Nimbus application. In addition to the distinct load power increase over the Nimbus B system realized with the parallel tracker configuration, this unit requires only the same spacecraft space as the NB system. This eliminates the possible excessive power dissipation condition that could be encountered in the NB storage modules when the shunt dissipator is activated. K.W.

N69-22184# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF MAGNETOHYDRO-DYNAMIC FLOW IN A DUCT WITH SECTIONIZED ELECTRODES
V. A. Kaidalov, E. I. Khanzhina, and E. I. Yantovskii May 1968 18 p Transl. into ENGLISH from Magnitn. Gidrodin. (Latvian SSR), no. 4, 1966 p 55–61
(AD-681595; FTD-MT-24-65-68) Avail: CFSTI CSCL 10/2

The paper deals with methods of calculation of the magnetohydro-dynamic flow in a duct on the basis of quasi-one-dimensional approach in the presence of the Hall effect, friction, heat exchange, and voltage drop near the electrodes with determination of corrections, considering the dimensions of the sectionized electrodes. The methods are illustrated by two examples of calculation of supersonic flow in an MHD-generator duct with load resistance connected across the duct terminals. Author (TAB)

N69-22316# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

EXPERIMENTAL INVESTIGATION OF TWO BLUNT-TRAILING-EDGE SUPERSONIC COMPRESSOR ROTORS OF DIFFERENT BLADE THICKNESSES AND WITH POLYNOMINAL CAMBER LINE Final Report, Jan.–May 1967

C. T. Carman, J. R. Myers, and A. J. Wennerstrom Jan. 1969 76 p refs

(Contract F40600-69-C-0001)

(AD-681488; AEDC-TR-68-251) Avail: CFSTI CSCL 13/7

Two configurations of blunt-trailing-edge supersonic compressor blades incorporating a polynomial camber line were tested with air in a compressor rig. The performance of these blades was investigated over the speed range from 50 to 100 percent of design speed. The performance at the two blade configurations is compared, and the effect of the modifications between the two configurations is evaluated. A comparison of selected performance data obtained with circular arc blading tested previously and the polynomial camber blading is made to evaluate the effects of the camber redistribution. Author (TAB)

N69-22325*# Boeing Co., Seattle, Wash. Aerospace Group.

SIMULATED SPACE ENVIRONMENTAL TESTS ON CADMIUM SULFIDE SOLAR CELLS Final Report

K. L. Kennerud 28 Feb. 1969 119 p refs

(Contract NAS3-6008)

(NASA-CR-72507; D2-121002-1) Avail: CFSTI CSCL 10B

Cadmium sulfide thin film solar cells were subjected to a simulated space environment similar to that encountered by a satellite in earth orbit. The environment included a pressure less than 10^{-6} torr, simulated space ultraviolet radiation, and thermal cycles in which cell temperature varied between −100°C and +60°C. Most cells exhibited a significant loss in power within 500 cycles, but one cell withstood over 2000 cycles without appreciable degradation. The degradation was characterized by: (1) increasing internal series resistance, (2) occasional internal shorting and (3) an unexplained loss in light generated current. Author

N69-22330*# Texas Instruments, Inc., Dallas. Components Group.

SOLAR CELL CONTACT DEPOSITION PARAMETER STUDY Quarterly Report, 30 Aug.–30 Nov. 1968

30 Nov. 1968 15 p

(Contract NAS5-11612)

(NASA-CR-100536; TI-03-68-89; QR-1) Avail: CFSTI CSCL 10B

The relationship between various contact evaporation parameters and the humidity resistance of the solar cell Ti-Ag contact are identified. The effects of various evaporation substrate temperatures from 0°C to 200°C have been evaluated. Evidence is presented, in the form of electron microscope photos, which shows that the grain size of the evaporated silver contact becomes larger when the evaporation substrate temperature is increased. This effect was expected since it has been established that the grain size of an evaporated metal film depends, to a great extent, on the mobility of the evaporated surface atoms, and this mobility is influenced by an increase or decrease in substrate temperatures. Data are presented which indicate that solar cell Ti-Ag contacts having the smallest grain size do exhibit a higher degree of humidity resistance. It is felt, however, that this effect is not the complete answer for a long-term high reliability solar cell contact. D.G.B.

N69-22457# Atomic Energy Commission, New York. Health and Safety Lab.

DETERMINING THE STATE OF CHARGE OF NICKEL-CADMIUM BATTERIES BY FARAD CAPACITANCE MEASUREMENTS

Norman Latner Aug. 1968 35 p refs

(PB-180860; HASL-198) Avail: CFSTI CSCL 10C

A rapid simple method was developed for determining state of charge of the widely used nickel-cadmium rechargeable battery. The method described is based on the experimentally verified relationship between farad capacitance and state of charge. Using this relationship, a standard reference curve (capacitance vs. state of charge) was established based on repeated runs of a specific battery type. By measuring the capacitance of any battery of this type and matching it to its standard reference curve, the state of charge is quickly determined. Author (USGRDR)

N69-22754# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.

SNAP-23A PROGRAM, PHASE 1. THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, Jul. 1–Sep. 30 1968

31 Oct. 1968 97 p

(Contract AT(30-1)-3824)

(MMM-3824-27) Avail: CFSTI

Initial performance testing, stability conditioning, and contract specification were completed on the Prototype Mock-up Converter (PMC-1A). Testing indicated an efficiency greater than design objectives. Parts were machined and processed for PMC-1B. Test data evaluation and analysis continued on test devices Experimental Mock-up Converter No. 2 (EMC-2), and No. 3 (EMC-3). 10-Couple modules No. 1, 3, 5 through 12, Converter 23 P-2, and 6-Couple Module 23 A-3, Ten-Couple modules, Nos. 2 and 4, have been removed from test after 8264 and 8242 test-hours for post-test analysis. NSA

N69-22898*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND PERFORMANCE OF TWO INTEGRATED CIRCUITS FOR FLUIDIC-CONTROLLED PNEUMATIC STEPPING MOTOR SYSTEM

Miles O. Dustin and Robert E. Wallhagen Washington Apr. 1969 50 p refs

(NASA-TN-D-5155) Avail: CFSTI CSCL 10B

Typical sizing calculations are demonstrated for determining the interconnecting line sizes. The integrated circuits control a nutator stepping motor up to 300 steps per second with a maximum output torque of 90 in.-lb (1020 cm-N) at zero speed. Author

N69-22926# Battelle Memorial Inst., Columbus, Ohio.

REFRACTORY-METAL THERMOCOUPLES IN NUCLEAR AND HIGH-TEMPERATURE APPLICATIONS

John W. Dr ge, Neil E. Miller, Marcus E. Schimek, Van E. Wood, and James J. Ward 22 Nov. 1968 39 p refs

(Contract W-7405-ENG-92)

(BMI-X-10246) Avail: CFSTI

The performance of platinum, tungsten tungsten–rhenium alloys, and molybdenum–rhenium alloys in thermocouples in nuclear reactor and high temperature environments was investigated, using

BeO, ThO_2, and Y_2O_3 as insulators and tantalum, niobium, and molybdenum as sheaths. Upon irradiation of thermoelement wires at 50°C both transmutation and displacement effects were found. Transmutation effects were small, and are probably insignificant except in long-term use. Thermodynamic analyses were made for various sheath–insulator systems suggested for use at 2200°K. Tests of thermal stability of thermal emf over long periods at 1800 and 2000°K showed that BeO, ThO_2, and Y_2O_3 were all satisfactory insulators; however, the BeO must be of high purity. Tantalum and niobium were inferior to molybdenum as sheaths; tungsten-3 wt % rhenium, tungsten-25 wt % rhenium, and molybdenum-50 wt % rhenium all proved satisfactory as thermoelement wires. Author (NSA)

N69-22940*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF TEMPERATURE AND ELECTROLYTE CONCENTRATION ON PERFORMANCE OF A FUEL CELL OF THE BACON TYPE
Robert E. Post Washington Apr. 1969 31 p refs
(NASA-TN-D-5154) Avail: CFSTI CSCL 10B

Performance was studied in terms of voltage-current data for temperatures ranging from 300° to 460°F (422 to 511K), KOH concentrations ranging from 70 to 82 wt. %, and reactant pressures of 22.4 psia ($1.54 \times 10^5 N/m^2$). The effect of increased concentration appeared as an upward displacement of the voltage-current curve and was two or more times that calculated from thermodynamic considerations. The effect of temperature appeared to be consistent with rate-process principles, in that it increased with current and decreased as equilibrium conditions were approached. Author

N69-23125# European Organization for Nuclear Research, Geneva (Switzerland).
CABLE TRANSFORMER FOR THE FORMATION OF HIGH-VOLTAGE PULSES OF SEVERAL NANOSECONDS DURATION[TRANSFORMATEUR A CABLES POUR LE FORMACE D'IMPULSIONS DE HAUTE TENSION D'UNE DUREE DE QUELQUES NANOSECONDES]
A. J. Nasbiov 1968 12 p Transl. into FRENCH from Russian Preprint No. 150 in FRENCH
(CERN-Trans-68-5) Avail: CFSTI

The principal calculation elements of the parameters of a cable pulsed transformer are given. The possibility of using the transformer for the formation of high voltage pulses on the order of one nanosecond is discussed. (NSA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N69-22003 Texas Univ., Houston. Graduate School of Biomedical Sciences.
ULTRAVIOLET LIGHT INDUCED MUTATION IN EXTRACTED DNA
Elmer Scheltgen (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-11227

Ultraviolet light irradiation of extracted DNA was shown to increase frequency of adenine revertants when analyzed by transformation in *B. subtilis* strain MuBu5u6-S. Statistical analysis of the data revealed that the results were significant at the 93 percent level. An increase in the temperature during transforming DNA uptake and incorporation was found to cause both a decrease in the transformation frequency and a decrease in the transforming activity of irradiated DNA relative to nonirradiated DNA. Attempts were made to induce auxotrophic mutations by ultraviolet light in extracted native and deratured DNA without success. Ultraviolet light irradiation of DNA at 100°C followed by slow cooling was found to produce a marked increase in the number of adenine reversions in DNA as detected by transformation of the adenine 8 subtilis strain MuBu5u6-S cells to prototrophy. Dissert. Abstr.

N69-22091# University of Southern Calif., Los Angeles.
STRUCTURAL STUDIES ON DEOXYRIBONUCLEIC ACID Final Report
Jerry Donohue May 1968 11 p refs
(Contract AT(11-1)-113)
(PB-180815) Avail: CFSTI CSCL 06A

A summary is given of studies including general and specialized areas of structural chemistry, with emphasis on the structure of DNA. These areas are not germane to the DNA problem, in that many structures of that molecule are found in simpler, related compounds. Author (USGRDR)

N69-22092# California Univ., Berkeley. Lawrence Radiation Lab.
OPTICAL PROPERTIES OF NUCLEIC ACIDS: 1. SOLVENT EFFECTS. 2. LOW TEMPERATURE, MATRIX ISOLATED BASES
Barrett Lynn Tomlinson (Ph.D. Thesis) Sep. 1968 219 p refs
(Contract W-7405-ENG-48)
(PB-180863; UCRL-18444) Avail: CFSTI CSCL 06A

Evidence is presented indicating that RNA is more strongly hydrated in the stacked than in the unstacked state, and that increasing hydration makes a positive contribution to the stability of the stacked form. A general method is proposed for the experimental determination of solvent contribution to the thermodynamics of stacking and denaturation in RNA and DNA. The utility of aliphatic alcohols as probes of the water-nucleic acid interactions was demonstrated. An n-pi transition was identified as the lowest energy singlet in adenine and 9-methyladenine in some nonpolar matrices. Evidence was presented for the existence of intermediate vibronic coupling between accidentally degenerate electronic states in substituted adenines and 1-methyluracil. Author (USGRDR)

N69-22094# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE CONTROL OF RIBOSOMAL PROTEIN SYNTHESIS IN ESCHERICHIA COLI
Harry G. Ungar (Ph.D. Thesis) Sep. 1968 138 p refs
(Contract W-7405-ENG-48)
(PB-180850; UCRL-18450) Avail: CFSTI CSCL 06A

The number of ribosomes in a growing bacterial cell is proportional to the rate of growth and of protein synthesis. When glucose is added to cells growing on a less rapidly metabolized carbon source they eventually achieve a higher growth rate characterized by a higher ratio of ribosomal to total protein. A technique was developed for following the synthesis of ribosomal protein during the transition from one growth condition to another. By double labeling the cells with 14C- and 3H-phenylalanine it was possible to measure both the cumulative ratio of ribosomal to total protein, and the differential rate of ribosomal protein synthesis, during the transition from the lower to the higher growth rate. Author (USGRDR)

N69-22101# Joint Publications Research Service, Washington, D. C.

SOVIET RESEARCH ON MECHANISMS OF PHOTOSYNTHESIS

17 Mar. 1969 64 p Transl. into ENGLISH from Russian
Avail: CFSTI

CONTENTS:

1. CORRELATION BETWEEN CHEMILUMINESCENCE OF PHOTOSYNTHESIZING ORGANISMS AND LIGHT REACTIONS OF PHOTOSYNTHESIS A. B. Rubin et al p 1–11 refs (See N69-22102 11-04)

2. INVESTIGATION OF PROCESSES OF LIGHT-INDUCED OXIDATION OF CYTOCHROMES IN PHOTOSYNTHESIZING PURPLE BACTERIA, RHODOPSEUDOMONAS SPECIES A. B. Rubin et al p 12–26 refs (See N69-22103 11-04)

3. INVESTIGATION OF KINETICS OF LIGHT-INDUCED REACTIONS OF INTRACELLULAR CYTOCHROMES OF RHODOPSEUDOMONAS SPECIES BACTERIA A. A. Kononenko et al p 27–41 refs (See N69-22104 11-04)

4. MATHEMATICAL DESCRIPTION OF PRIMARY ELECTRON TRANSPORT PROCESSES IN PHOTOSYNTHESIS A. B. Rubin et al p 42–53 refs (See N69-22105 11-04)

5. LIGHT ENERGY STORAGE BY PHOTOSYNTHETIC ORGANISMS AT LOW TEMPERATURES A. B. Rubin et al p 54–61 refs (See N69-22106 11-04) $)

N69-22102# Joint Publications Research Service, Washington, D. C.

CORRELATION BETWEEN CHEMILUMINESCENCE OF PHOTOSYNTHESIZING ORGANISMS AND LIGHT REACTIONS OF PHOTOSYNTHESIS

A. B. Rubin et al *In its* Soviet Res. on Mech. of Photosyn. 17 Mar. 1969 p 1–11 refs Transl. into ENGLISH from Fiziol. Rast. (Moscow), v. 15, no. 1, Jan./Feb. 1968 p 34–40 (See N69-22101 11-04)
Avail: CFSTI

Some of the kinetic distinctions of chemiluminescence were studied under photic stimulation with different spectral compositions, as well as under the effects of photosynthesis inhibitors, such as DCP, diuron, and salicylaldoxime. Afterglow extinction curves, for beam leaves, Vallisneria leaves, and Scenedesmus algae suspensions, were plotted two to three seconds after discontinuation of a thirty second photic stimulus. Excitation spectra were obtained for each of the persistence components of the photosynthesizing organisms. The excitation spectrum of the first component, with a duration in the order of 10^{-2} seconds, has a maximum at 675 to 680 mmk; the second, lasting up to one minute, at 645 to 650 mmk; and the third, lasting over one minute, at 695 to 700 mmk. Inhibitor effects are discussed with regard to the three afterglow components. The appearance of a maximum on the afterglow extinction curve during remote red light stimulation (third component) is apparently related to closing of the chain of cyclic electron transfer, sensitized by the long wave form of chlorophyll. P.A.B.

N69-22103# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF PROCESSES OF LIGHT-INDUCED OXIDATION OF CYTOCHROMES IN PHOTOSYNTHESIZING PURPLE BACTERIA, RHODOPSEUDOMONAS SPECIES

A. B. Rubin et al *In its* Soviet Res. on Mech. of Photosyn. 17 Mar. 1969 p 12–26 refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 3, 1968 p 372–381 (See N69-22102 11-04)
Avail: CFSTI

The light-induced reactions of intracellular cytochromes of photosynthesizing purple bacteria, Rhodopseudomonas species (Rh.sp.), were investigated by the method of highly sensitive differential absorption spectrophotometry. Analysis of changes in spectra of cell suspension absorption, induced by close infrared light under controlled change in medium composition and gas phase, led to the conclusion that intracellular cytochromes of Rh.sp. participating in the photochemical reaction can also interact with oxygen. A study was made of the effect of four inhibitors of oxidizing-reducing reactions (potassium cyanide, salicylaldoxime, 2-n-heptyl-4-hydroxyquinoline N-oxide, and antimycin) on light and oxygen activated processes of electron transfer in Rh.sp. Author

N69-22104# Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF KINETICS OF LIGHT-INDUCED REACTIONS OF INTRACELLULAR CYTOCHROMES OF RHODOPSEUDOMONAS SPECIES BACTERIA

A. A. Kononenko et al *In its* Soviet Res. on Mech. of Photosyn. 17 Mar. 1969 p 27–41 refs Transl. into ENGLISH from Molekul. Biol., Akad. Nauk SSSR, Inst. Radiats. i Fiz.-Khim. Biol. (Moscow), v. 2, no. 6, Nov./Dec. 1968 p 807–817 (See N69-22102 11-04)
Avail: CFSTI

Data obtained on the effect of the inhibitor, quinacrine, on light-induced transformations of intracellular type C cytochromes in Rhosopseudomonas species purple bacteria are indicative of the presence of feedback reaction between primary photoreduced products and photooxidized cytochromes. The complex kinetics of the processes observed may be explained by assuming the participation in them of one type C cytochrome which functions in the photosynthetic chain of electron transfer in these bacteria. Author

N69-22105# Joint Publications Research Service, Washington, D. C.

MATHEMATICAL DESCRIPTION OF PRIMARY ELECTRON TRANSPORT PROCESSES IN PHOTOSYNTHESIS

A. B. Rubin et al *In its* Soviet Res. on Mech. of Photosyn. 17 Mar. 1969 p 42–53 refs Transl. into ENGLISH from Biol. Nauka-Selsk. i Lesn. Khoz., Akad. Nauk Latv. SSR, Otd. Biol. Nauk (Latvian), no. 12, 1968 p 59–67 (See N69-22102 11-04)
Avail: CFSTI

Systems of nonlinear differential equations describing electron transfer processes in a photosynthetic chain have been prepared and analyzed. The data on kinetics of oxidizing-reducing conversions of cytochromes in the cells of purple bacteria and correlation between chemiluminescence of Chlorella cells and the effect of inhibitors confirm the conceptions presented in this article as to the nonlinear nature of electron transfer in photosynthesis. Author

N69-22106# Joint Publications Research Service, Washington, D. C.

LIGHT ENERGY STORAGE BY PHOTOSYNTHETIC ORGANISMS AT LOW TEMPERATURES

A. B. Rubin et al *In its* Soviet Res. on Mech. of Photosyn. 17 Mar. 1969 p 54–61 refs Transl. into ENGLISH from Biofizika (Moscow), v. 14, no. 1, Jan./Feb. 1969 p 105–109 (See N69-22102 11-04)
Avail: CFSTI

Photosynthetic organisms showed thermoluminescence (green algae and leaves of higher plants) with maxima at temperatures below +50°C. Thermoluminescence was stimulated at low temperatures, down to −180°C. Diuron and salicylaldoxime, which are inhibitors of photosynthesis, alter the location of the peak of thermoluminescence. In the excitation spectrum of thermoluminescence, the peak is located at 680 mmk. It is assumed that thermoluminescence develops in the course of feedback

reactions in intermediate carriers located in the photosynthetic chain of electron transport between the first and second photochemical systems. Author

N69-22178*# Franklin Inst., Philadelphia, Pa. Research Labs.
[PART 1: ELECTRODE DESIGN. PART 2: EXPERIMENTAL DESIGN Quarterly Report, Nov. 1968–Feb. 1969]
A. Marmarou Feb. 1969 5 p
(Contract NASw-1841)
(NASA-CR-100533; QR-15G-C2430-1) Avail: CFSTI CSCL 06P

The development of electrodes for long-term implantation and measurement of the evoked response is described. The stimulating electrodes are of the coaxial, concentric bipolar type. The outside pole is a stainless steel tube 0.8 mm thick, the internal pole a .45 mm wire. This wire was factory insulated and protrudes beyond the stainless steel cannula by approximately 0.5 mm. The entire electrode is completely insulated with an epoxy resin. The impedance of the electrode is between 1 and 3 megohms. Insulated copper wire with an exposed tip of .5 mm is used for the recording electrodes. Both types of electrodes were implanted in the hippocampus and cerebral cortex, and typical evoked response data were obtained following a 5-day stabilization period and stimulation of the fornix-septum area. Application of the electrodes and design of a rat experiment are briefly outlined. K.W.

N69-22196*# State Univ. of New York at Buffalo.
INDIVIDUAL AND CORPORATE SOURCES OF MOTIVATION: A PRELIMINARY INVESTIGATION
Raymond G. Hunt and Ira S. Rubin Mar. 1969 30 p refs
(Grant NGR-33-015-061)
(NASA-CR-100556; TR-3) Avail: CFSTI CSCL 05J

Two separate sets of rating scales were administered to a sample of expert judges. The rating scales paired nine individual component motivations and nine corporate motivations with statements reflecting possible conditions for the fulfillment of the tendencies. Responses were factor analyzed to determine underlying motivational dimensions. The results indicated that the dominant sources of motivation for both individuals and industrial organizations were located along four dimensions: external and internal, control, interpersonal concern, security and self-actualization. Author

N69-22207*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOOD CONSUMPTION ON THE GEMINI 4, 5, AND 7 MISSIONS
Paul A. Lachance, Robert A. Nanz, and Mary V. Klicka (Army Natick Labs.) Oct. 1967 4 p refs
(NASA-TM-X-58010) Avail: CFSTI CSCL 06H

Food for the Gemini IV mission consisted of a 4-day cycle menu which provided four meals per day, for a total of 2550 calories. An average of 2100 calories per day was ingested by the crew in flight. Food for the Gemini V mission consisted of a 3-day cycle menu which provided three meals per day (2650 calories). Because of low food consumption during the flight, the average daily intake for the crew was approximately 1000 calories. Food for the Gemini VII mission consisted of a 4-day cycle menu which provided three meals per day (2450 calories). Average daily intake by the crew during this flight was 1789 calories. The calculated caloric requirements have been compared with the calories and major nutrients actually consumed in flight. The body-weight loss of each crewman is discussed in terms of tissue loss and water loss. Author

N69-22257# School of Aerospace Medicine, Brooks AFB, Tex.
INDOLYLALKYLAMINES AS RADIOPROTECTANTS. NOVEMBER 1965–MARCH 1968
Emmett J. Stork, Arthur E. Gass, Jr., and George S. Melville, Jr. Oct. 1968 13 p refs
(AD-681502; SAM-TR-68-114) Avail: CFSTI CSCL 6/18

To determine whether a combination of derivatives causes less toxicity in achieving the radioprotective effect of tryptamine, laboratory rats were injected intraperitoneally with 5-hydroxytryptamine alone, and in combination with 5-methoxytryptamine and sodium hexobarbital, before exposure to 1,200 R gamma radiation. Results show that survival increases when the agents are given in certain combinations. Thirty-day survival (27/30) of rats treated with the triple drug combination was significantly greater than the survival of rats treated with any of the drugs individually. These data suggest that an additive or synergistic effect may be present when the agents are administered in combination. The data also suggest that radioprotection by indolylalkylamines is more effective against 1,200 R gamma delivered over a short interval than against the same dosage over a more extended interval. The optimum time for drug administration was found to be approximately 15 minutes before irradiation. To extend this radioprotection to primates, Macaca mulatta were injected intraperitoneally with the triple drug combination before exposure to 850 R x-rays. Of the treated primates, 4 out of 15 survived. Author (TAB)

N69-22273# Kansas State Univ., Manhattan. Dept. of Psychology.
SOME PROBLEMS ENCOUNTERED WHILE TRAINING CATS TO PERFORM A VISUAL TRACKING TASK. PHOTOPIC AND SCOTOPIC SPECTRAL SENSITIVITY FUNCTIONS OF THE CAT
Robert Hill Lamotte and John Lott Brown Nov. 1968 28 p refs
(Contract Nonr-3634(04))
(AD-682247; TR-9; TR-10) Avail: CFSTI CSCL 6/3

Data are presented based on a behavioral study of the spectral sensitivity of the cat under both photopic and scotopic conditions. Results are compared with those of electrophysiological studies as well as with other behavioral studies of the cats spectral sensitivity. Author (TAB)

N69-22293# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF LABORATORY REPROCESSING ON SILVER PHOSPHATE GLASS MICRODOSIMETERS, JANUARY 1966–MARCH 1967
Kenneth A. Hardy and Rufus Werts Sep. 1968 12 p refs
(AD-681497; SAM-TR-68-96) Avail: CFSTI CSCL 6/18

The purpose of this three-phase experimental study was to determine the effects of laboratory reprocessing on silver phosphate glass rod microdosimeters. Results show that the microdosimeters may be brought back to their nonirradiated condition by heating at 450C for one hour. According to these studies, a small loss of sensitivity occurs after the initial reprocessing but the linearity does not appear to be affected. Further reprocessing gave no apparent loss in sensitivity even after repeated exposures up to a cumulative dose of 97,500 R. Author (TAB)

N69-22294# School of Aerospace Medicine, Brooks AFB, Tex.
ADAPTATION OF DOGS TO 60 AND 90 MM. HG CO2 AT A TOTAL PRESSURE OF 260 MM. HG Final Report, Oct. 1966–Jan. 1967
William E. Papelko Aug. 1968 14 p refs
(AD-681496; SAM-TR-68-70) Avail: CFSTI CSCL 6/3

Two groups of 6 dogs were exposed continuously for 9 days to an environment having a total barometric pressure of 260 mm. Hg, a partial pressure of 140 mm. Hg O2, and either 60 or 90 mm. Hg CO2. Arterial samples were collected daily from a previously exteriorized carotid artery. Data from the present experiment were compared with those of previous researchers working with chronic hypercapnic dogs at ground-level pressure. Author (TAB)

N69-22313# School of Aerospace Medicine, Brooks AFB, Tex.
A STANDARD METHOD FOR FE59 FERROKINETICS, JANUARY–MARCH 1968
Donald F. Logsdon, Jr., James F. Green, and Guy M. Strong Sep. 1968 13 p refs
(AD-681498; SAM-TR-68-98) Avail: CFSTI CSCL 6/1

A simple method for performing a 59Fe ferrokinetics study has been developed, combining several procedures already in use. Methods are presented for measuring plasma iron clearance, red cell iron uptake, and the movement of iron through the hematopoietic centers. Formulas are given for calculating plasma and red cell iron turnover, hemoglobin synthesis, mean erythron life-span, and mean effective erythron hemoglobinization time. Author (TAB)

N69-22319*# Wisconsin Univ., Madison.
COMPUTER SIMULATION STUDIES OF THE VENOUS CIRCULATION
M. F. Snyder and V. C. Rideout [1968] 24 p refs
(Grant NGR-50-002-083)
(NASA-CR-100568) Avail: CFSTI CSCL 06P

An analog computer model of the human cardiovascular system has been set up in which detailed attention is given to the representation of pressure—flow events in the veins, including effects of gravity, collapse, breathing, and venous valves. This model, with its only control loop including one for heart rate control, was checked against human venous pressure waveforms and also response of the human to tilt-table experiments as reported in the literature. These comparisons indicate that the model should be valid for study of postulated venous tone control characteristics, and should be useful in the study of mechanisms of venous return and circulatory system response during unusual G-force conditions. Author

N69-22322*# Mississippi Univ., University. Dept. of Physiology and Biophysics.
CONCEPTUAL IDEA OF DIGITAL COMPUTER MODEL OF HUMAN RESPIRATORY SYSTEM Progress Report, 1 Jun.–30 Nov. 1968
H. T. Milhorn, Jr. 30 Nov. 1968 22 p refs
(Grant NRG-25-002-015)
(NASA-CR-100534) Avail: CFSTI CSCL 06P

In the development of a digital computer model of the human respiratory system two types of research are presently being pursued. These are (1) simulation and (2) experimental. The simulation work is primarily to extend and improve the controlled system, specifically the pulmonary system. The experimental work concerns the controller equations for ventilation and cardiac output. A detailed discussion of both of these (simulation and experimental) is impractical, however, some of the more important aspects are discussed. Author

N69-22433# Systems Technology, Inc., Hawthorne, Calif.
PILOT RATING TECHNIQUES FOR THE ESTIMATION AND EVALUATION OF HANDLING QUALITIES Final Technical Report
John D. McDonnell Wright-Patterson AFB, Ohio AFFDL Dec. 1968 214 p refs
(Contract AF 33(615)-3960)
(AD-681845; STI-TR-166-1; AFFDL-TR-68-76) Avail: CFSTI CSCL 05/10

Although rating scales of varied forms have been widely used to estimate and evaluate handling qualities over the past decade, a number of deficiencies in both method and data base have been apparent. The investigation was aimed at overcoming many of these deficiencies by attempting to resolve the difficulties experienced with rating scales themselves, and by extending and adding to already existing relationships between ratings and pilot/vehicle system parameters. Rating scales have come under increasing criticism for problems such as wording ambiguity, the dual mission character of some scales, the nonuniformity in the distribution of descriptors across the scale, and the misuse of scales which has occurred when ratings have been averaged. Psychometric methods provide an approach to these problems, and were used to scale several phrases descriptive of vehicle handling qualities. Thus, quantitative characteristics were derived for contemporary scales through the use of the Method of Successive Intervals. An experiment was conducted which added to available data relating Cooper ratings and pilot/vehicle parameters, and which also tested some potential alternate scale candidates. The correlation results indicate that ratings are probably based on performance and the degree of difficulty experienced in maintaining the performance. The difficulty is most easily represented by the pilot equalization required and the vehicle stick characteristics. Author (TAB)

N69-22466*# Techtran Corp., Glen Burnie, Md.
DEMONSTRATION OF THE OCCURRENCE OF ALBINISM, MELANISM AND NEOTENY IN FROGS, 2. A NEW CONTRIBUTION TO BIO-TECHNOLOGY [2. NACHWEIS UBER DAS ENTSTEHEN VON ALBINISMUS, MELANISMUS UND NEOTENIE BEI FROSCHEN, EIN NEUER BEITRAG ZUR BIOTECHNIK]
Gustav Tornier Washington NASA Mar. 1969 6 p ref Transl. into ENGLISH from Zool. Anz. (Leipzig), v. 32, 1908 p 284–288
(Contract NASw-1695)
(NASA-TT-F-12150) Avail: CFSTI CSCL 06C

To determine to what degree vegetable substances are exclusively suitable for raising Pelobates larvae, numerous specimens were fed exclusively with filamentism algae and algaes and food containing meat was strictly excluded. The experimental animals developed slowly to a certain size by using the remainder of nutritive yolk still in their cells from the egg period and subsequently died. Pelobates larvae which have just left the egg cannot develop on pure vegetable feed and cannot stay alive when fed on algae. When fed on algae and meat they develop to medium size with short rear limbs, and if they are subsequently fed exclusively on filamentous algae they stay alive but do not develop further. Author

N69-22475*# Techtran Corp., Glen Burnie, Md.
THE ASYMMETRICAL DEVELOPMENT AND SITUS INVERSUS VISCERUM IN TWINS AND DOUBLE STRUCTURED ORGANISMS [UBER AYMMETRISCHE ENTWICKLUNG UND SITUS INVERSUS VISCERUM BEI ZWILLINGEN UND DOPPELBILDUNGEN]
Hans Spemann and Herman Falkenberg Washington NASA Apr. 1969 45 p refs Transl. into ENGLISH from Arch. Entwicklungsmech. Organ. (Berlin), v. 45, 1919 p 371–420
(Contract NASw-1695)
(NASA-TT-F-12148) Avail: CFSTI CSCL 06C

From triton embryos which are separated at the median at the beginning of gastrulation, twins are developed with a

strongly curved inner side. A number of symmetrically developed twin pairs were kept alive until metamorphosis. The organs of the inner side could be more weakly developed individually or in entirety. In the case of corresponding twins being different sizes due to unequal size of the parts, the smaller twin is behind the larger twin in development. The head of the larvae achieves a much higher degree of symmetry than the trunk and tail, even in cases where the latter are wound into a spiral, the head can be almost normally developed. As a result of this curvature of the inner side the twin larvae can almost be differentiated into right and left. The asymmetry of the situs cannot arise at the moment it first becomes visible. Various points could be determined in this causal framework. Author

N69-22504*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
FURTHER CONTRIBUTIONS TO THE KNOWLEDGE OF GEOTROPIC STIMULUS MOVEMENTS [WEITERE BEITRAGE ZUR KENNTNIS DER GEOTROPISCHEN REIZBEWEGUNGEN]
Fredrich Czapek Washington NASA Apr. 1969 113 p refs Transl. into ENGLISH from Jahrb. Fur Botanik (Germany), v. 32, 1898 p 174–308
(Contract NASw-1692)
NASA-TT-F-12085) Avail: CFSTI CSCL 06F

Observations are presented on the reaction of plants to stimulating movements and on the manipulation of various factors to influence the reactions. Experiments are discussed which seek to determine the means or the mechanisms through which plants react to external stimuli. Reception and duration of stimulation, magnitude of the stimulus, force and sensitivity, gravity directions, thermal factors, chemical reactions, traumatic stimuli, and transmission of the stimuli within the plant are examined by studying the results obtained in experiments with a wide variety of plants. It is concluded that stimulus movement should be classified as reflex movement; it can be considered in terms not unlike those used in animal physiology, since such processes as perception, ductory functions, central transmission, and motor functions can also be distinguished here. K.W.

N69-22528# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
RADIOPROTECTIVE PROPERTIES OF SOME HETEROCYCLIC NITROGENOUS COMPOUNDS AGAINST CHANGES IN HEMOGLOBIN CONCENTRATION AND HEMATOCRIT VALUE IN X IRRADIATED MICE [PROPRIETES RADIOPROTECTRICES DE CERTAINS COMPOSES HETEROCYCLIQUES AZOTES SUR LES VARIATIONS DU TAUX D'HEMOGLOBINE ET DE LA VALEUR HEMATOCRITE CHEZ LA SOURIS IRRADIEE]
Hamid Rousdhy (CEA, Cairo), Theodore Pierotti, and Michel Polverelli Jan. 1969 22 p refs In FRENCH; ENGLISH summary
(CEA-R-3669) Avail: CFSTI

Radioprotective properties of imidazole and benzimidazole have been proved in previous work. In this study, the radioprotective action of these compounds in comparison with cysteamine upon the hematopoietic system after lethal X-irradiation has been examined. The results show that (1) no drastic variations of the hematologic constants (hemoglobin concentration and hematocrit value) occur after the intraperitoneal injection of radioprotective compounds apart from certain apparent reactions with heterocyclic compounds and (2) the better radioprotective action of benzimidazole. Twenty-five days after irradiation, the hemoglobin concentration and the hematocrit of radioprotected mice return to normal values. Author (ESRO)

N69-22534*# National Academy of Sciences—National Research Council, Washington, D. C. Space Science Board.
PHYSIOLOGY IN THE SPACE ENVIRONMENT. VOLUME 1: CIRCULATION Study Report, 1966–1967
1968 196 p refs Sponsored by NASA
(NASA-CR-100535; Publ-1485A) Avail: CFSTI CSCL 06P

Evaluated are possible effects of prolonged space flight on the human circulatory system by considering: (1) the various parts and functions of the circulatory system; and (2) the various stress factors to which the system may be subjected. A systems approach with computerized models is used to incorporate those nervous, endocrine, and other factors that control and regulate circulatory cardiovascular functions characteristic of manned space flight elements. G.G.

N69-22557# California Univ., Berkeley. Lawrence Radiation Lab.
AMINOACYLIC DERIVATIVES OF NUCLEOSIDES, NUCLEOTIDES AND POLYNUCLEOTIDES. 2: SYNTHESIS OF 3 ′ (2 ′)–O–AMINOACYLNUCLEOSIDE-5 ′-di-AND TRIPHOSPHATES
P. P. Purycin et al 1968 19 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), No. 5, 1968 p 1084–1087
(PB-180856T; UCRL-Trans-1381) Avail: CFSTI CSCL 06A

A method was developed for synthesizing 3′ (2′)-O-aminoacylnucleoside 5′-di-and triphosphates. The method is based on condensing imidazolides of N-tert. butyloxycarbonylamine acids with necleosidedi-and triphosphates and subsequently removing the tert. butyloxycarbonyl protection by treating with hydrogen chloride in abs. ether. Author (USGRDR)

N69-22568# School of Aerospace Medicine, Brooks AFB, Tex.
EFFECTS OF RIGHT AND LEFT VAGAL COOLING ON HEART RATE Interim Report, Feb.–Jul. 1968
William G. Davis, Jr. Nov. 1968 11 p refs
(AD-682289; SAM-TR-68-129) Avail: CFSTI CSCL 6/16

A study was made of the heart rate response to blockade of the right and left cervical vagosympathetic nerve trunks. In six dogs, coolers were surgically implanted around both cervical vagosympathetic nerves which permitted us to block the parasympathetic control of the heart in conscious resting dogs. With the left vagosympathetic nerve blocked there was a slight increase in heart rate and the respiratory sinus arrhythmia did not disappear. With blockade of the right vagosympathetic nerve there was a substantial heart rate increase and the respiratory sinus arrhythmia usually disappeared. There was a significant difference in the heart rate with blockade of the right as compared with the left vagosympathetic nerve trunk, indicating that the right trunk is more dominant in the resting dog and more inhibitory impulses travel over this route. The heart rate changes summed together, however, do not equal the rate observed with bilateral blockade. Author (TAB)

N69-22637*# Systems Technology, Inc., Hawthorne, Calif.
DYNAMICS OF THE VESTIBULAR SYSTEM AND THEIR RELATION TO MOTION PERCEPTION, SPATIAL DISORIENTATION, AND ILLUSIONS
Richard A. Peters Washington NASA Apr. 1969 249 p refs
(Contract NAS2-3650)
(NASA-CR-1309; TR-168-1) Avail: CFSTI CSCL 06P

In piloting tasks, visual observation of instrument indicators and of the visual field and sensations of motion, provide the sensible signals upon which the pilot bases his control of the aircraft. Variations of the gravitational-inertial force environment during the flight of an aircraft affect the pilot's motion sensors in his vestibular system and through them affect his control of the vehicle, his visual process, and his sense of orientation. A study

is made of the basic physiology of the human vestibular system and its interconnection with the oculomotor system. The dynamic functions of the semicircular canals and utricles (otolith organs) and the relation between subjective perceptions of motion and the accelerations which produce them are studied. Mathematical models of the dynamic functions of the vestibular system are presented. The various illusions experienced by pilots of aircraft are related to the accelerations which produce them and to the dynamics of the vestibular sensors involved. Author

N69-22771# Atomic Energy Commission, Idaho Falls, Idaho.
SPECIAL APPLICATIONS OF THERMOLUMINESCENCE DOSIMETRY
John P. Cusimano, Foster V. Cipperley, and John C. Culley. June 1968 13 p Presented at the 13th Ann. Meeting of the Health Phys. Soc., Denver, 16–20 Jun. 1968
(IDO-12068; CONF-680607-10) Avail: CFSTI

The results of recent experiments in thermoluminescence dosimetry are presented. A good gross integrated exposure correlation was indicated by a year-long exposure comparison field test using lithium fluoride-teflon dosimetry and beta-gamma film packets on ten high-exposure-probability individuals. Intercomparison of film, lithium fluoride-teflon discs, lithium fluoride phosphor, ferric sulphate solution, ionization chambers, R meters, glass dosimeters and electroscopes similarly exposed to a gamma source showed a close correlation for shielded response. The average ratio of shielded film response to shielded lithium fluoride-teflon disc response for various distances from the source was 1.04 while the average ratio of unshielded or open-window film response to the disc was 2.1. Author (NSA)

N69-22783# Milan Univ. (Italy).
BRAIN STEM SYSTEMS AND BEHAVIOR Final Scientific Report, 1 Jun. 1967–31 May 1968
Cesare Bartorelli and Alberto Zanchetti Jul. 1968 48 p refs
(Grant (AF-EOAR-4-67)
(AD-681532; AFOSR-69-0179TR) Avail: CFSTI CSCL 6/16

During the year covered by this report, work has been performed along the following lines: (1) Regulation of circulation during the wakefulness-sleep cycle. Experiments performed in totally sympathectomized cats have shown that the hemodynamic pattern most usually observed during desynchronized sleep is greatly modified by sympathectomy. (2) Regulation of circulation during emotional behavior. (a) Fighting. Fighting was elicited in unanesthetized cats as a natural reaction to another cat, in which attack was induced by brain stimulation. (b) Preparation for fighting. Cardiovascular changes during preparation for fighting have been compared with those during actual fighting in unanesthetized cats. Several of the functions measured changed differently in the two conditions. It is suggested that some of these differences may derive from the exertion component of fighting which may overwhelm other central neural influences common to fighting and preparation for fighting and related to emotion. Author (TAB)

N69-22850# Colorado Univ., Boulder.
RADIATION EFFECTS IN BIOCHEMISTRY AND ORGANIC CHEMISTRY Technical Progress Report, 15 Oct. 1967–14 Oct. 1968
10 Jul. 1968 49 p refs
(Contract AT(11-1)-690)
(COO-690-32) Avail: CFSTI

The effects of ionizing radiation on purified compounds in biological systems were studied with emphasis placed on the effects of radiation on proteins in the solid state. Phases of study included the effects of gamma radiation on solid state aspartate transcarbamylase from *Escherichia coli*, protein association of aspartate transcarbamylase, radiation scavengers in irradiated lysozyme and denaturation of irradiated lysozyme, and the hydrogen exchange and perturbation spectra of irradiated lysozyme. NSA

N69-22851# Oregon State Univ., Corvallis. Dept. of Botany.
THE ROLE OF NATURALLY OCCURRING QUINONES IN PHOTOSYNTHESIS Yearly Progress Report, Sep. 1967–1 Sep. 1968
Norman I. Bishop 1 Sep. 1968 10 p refs
(Contract AT(45-1)-1783)
(RLO-1783-18) Avail: CFSTI

It is found that uv radiation resulted in the destruction of plastoquinone. It was noted that uv radiation caused a decrease in the variable yield fluorescence. A number of phospholipases and galactolipases were examined for their effect upon inactivation of chloroplast reactions and upon fluorescence for comparison with uv effects; the effects were identical. For studies on the role of plastoquinone in photosynthesis, a series of mutants of the alga, *Scenedesmus obliquus*, were isolated. Analysis of isolated pigments revealed no major change in these fractions nor in the various lipids of the chloroplasts. Electron microscopy revealed no structural alteration of the chloroplasts. However, when a sufficiently refined technique for the separation of the various quinone fractions of these mutants was developed such that plastoquinone could be separated from vitamin K and other substances it became apparent that of ten mutants examined eight had altered ratios of plastoquinone: chlorophyll. NSA

N69-22863# Texas Univ., Austin.
EFFECTS OF RADIATION ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSICAL AND BIOCHEMICAL SYSTEMS Progress Report, 1 Sep. 1967–1 May 1968
Mary L. Alexander 1 May 1968 18 p refs
(Contract AT(40-1)-3014)
(ORO-3014-3) Avail: CFSTI

Progress of the programs on dose fractionation studies on spermatogonia of *Drosophila melanogaster* and combined x-ray and ethylenimine treatments for induction of mosaic mutations is reported. Initial studies on mutagenic potentialities of DNA feeding for Drosophila are discussed. NSA

N69-22859# California Univ., Berkeley. Lawrence Radiation Lab.
BIOLOGY AND MEDICINE Semiannual Report, Fall 1967
John H. Lawrence, ed. 1967 195 p refs
(Contract W-7405-eng-48)
(UCRL-18066) Avail: CFSTI

CONTENTS:

1. THE EFFECTS OF GRADED ERYTHROPOIETIC STIMULATION ON RED BLOOD CELL SURVIVAL IN THE MOUSE AND RAT S. A. Landaw p 1–4 refs (See N69-22860 11-04)

2. RADIATION-INDUCED MITOTIC SEGREGATION IN YEAST S. Nakai and R. K. Mortimer p 26–37 refs (See N69-22861 11-04)

3. STANDARD BIOLOGICAL TEST SPECIMENS FOR USE IN THE SCANNING ELECTRON MICROSCOPE T. L. Hayes, J. R. S. Manning, and R. M. Glaeser p 50–57 refs (See N69-22862 11-04)

4. MICRODOMAIN STRUCTURE-ANALYSIS OF BIOLOGICAL SPECIMENS BY ELECTRON DIFFRACTION R. M. Glaeser p 64–73 refs (See N69-22863 11-04)

5. A CALCULATION OF THE PHYSICAL CHARACTERISTICS OF NEGATIVE PION BEAMS. ENERGY-LOSS DISTRIBUTION AND BRAGG CURVES S. B. Curtis and M. R. Raju p 106–122 refs (See N69-22864 11-04)

6. THE MEASUREMENT OF THE EFFECTS OF X RAYS AND HELIUM IONS ON THE PROLIFERATIVE CAPACITY OF LYMPHOMA ASCITES TUMOR CELLS in vivo J. M. Feola, J. H. Lawrence, and G. P. Welch p 151–165 refs (See N69-22865 11-04)

7. USE OF A MODIFIED INSULIN TOLERANCE TEST TO MEASURE GROWTH HORMONE RESERVE IN PITUITARY DISEASES J. A. Linfoot, J. F. Garcia, N. J. Snyder, E. Manougian, R. A. Carlson et al p 166–172 refs

8. DELAYED RADIONECROSIS OF THE CENTRAL NERVOUS SYSTEM L. W. McDonald, J. H. Lawrence, J. L. Born, and J. T. Lyman p 173–192 refs

9. HEAVY PARTICLE RADIOSURGERY IN CUSHING'S DISEASE J. A. Linfoot, E. Manougian, C. A. Tobias, J. L. Born, N. J. Snyder et al p 193–198 refs

N69-22860*# California Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECTS OF GRADED ERYTHROPOIETIC STIMULATION ON RED BLOOD CELL SURVIVAL IN THE MOUSE AND RAT
Stephen A. Landaw *In its* Biol. and Med. 1967 p 1–14 refs Sponsored in part by NIH, NASA, and AEC (See N69-22859 11-04)
(Contract W-7405-eng-48)
Avail: CFSTI CSCL 06/S

Red blood cell (RBC) survival was studied in LAF_1 mice and Buffalo rats following hypoxia, erythropoietin injection, repeated phlebotomy, or phenylhydrazine induced anemia, using a technique based upon the endogenous production of ^{14}CO in the breath following the injection of glycine-2-^{14}C. Despite estimated hemoglobin synthesis rates 8 or more times normal, in no instances were there any increases in the rate of random destruction of the produced RBC, nor was there the production of a component of extremely short-lived cells. Ineffective hemoglobin synthesis appeared to be either normal or decreased, with the exception of rats studied shortly after injection of phenylhydrazine, suggesting a toxic effect of the drug in this time period. A modest but significant shortening of the mean potential lifespan (senescent destruction) was seen, which increased linearly with increasing hemoglobin synthesis rate. This shortening never exceeded 35% and no shortening of any significant degree was seen unless estimated hemoglobin synthesis rates were more than 2–3 times normal.
Author

N69-22861*# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION INDUCED MITOTIC SEGREGRATION IN YEAST
Sayaka Nakai and Robert K. Mortimer *In its* Biol. and Med. 1967 p 26–37 refs Sponsored in part by AEC and NASA (See N69-22859 11-04)
Avail: CFSTI CSCL 06R

Studies were made on *Saccharomyces cerevisiae* following exposure to doses of 15, 40, or 80 krads of X-radiation or to uv radiation. Results indicated that the principal mechanism of radiation-induced sectoring in diploid yeast was mitotic crossing over. Approximately 80% of the colonies were sectored for all genes distal to one of the seven intergenic regions. Genetic analysis showed that these colonies were reciprocal with respect to the genotypes of opposite sectors. A positive correlation between sectoring frequency and centromere distance was observed, as is expected for mitotic crossing over. It was possible that mitotic gene conversion, that should show no centromere dependence, predominated at these high exposures. If only a fraction of the population of cells was competent for mitotic crossing over, this event could saturate at relatively low doses, allowing other events such as gene conversion to predominate.
Author (NSA)

N69-22862# California Univ., Berkeley. Lawrence Radiation Lab.
STANDARD BIOLOGICAL TEST SPECIMENS FOR USE IN THE SCANNING ELECTRON MICROSCOPE
Thomas L. Hayes, Ja Rue S. Manning, and Robert M. Glaeser *In its* Biol. and Med. 1967 p 50–57 refs (See N69-22859 11-04)
Avail: CFSTI

Scanning electron micrographs of familiar biological specimens (tobacco mosaic virus, polystyrene latex spheres, lipoprotein macromolecules, and collagen) are presented as reference material for testing the performance of a scanning electron microscope and to demonstrate the kinds of information available at the present time with this instrument.
Author

N69-22863# California Univ., Berkeley. Lawrence Radiation Lab.
MICRODOMAIN STRUCTURE-ANALYSIS OF BIOLOGICAL SPECIMENS BY ELECTRON DIFFRACTION
Robert M. Glaeser *In its* Biol. and Med. 1967 p 64–73 refs (See N69-22859 11-04)
(Grant PHS GM-15129-01)
Avail: CFSTI

The current results are described of preliminary studies which are being carried out in order to determine the feasibility of obtaining: (1) diffraction patterns from single cell membranes and (2) high-resolution diffraction data from crystalline macromolecules. Results obtained with model specimens have revealed a number of instrumental limitations of the conventional electron microscope for such studies. The data reported here indicate that one of the most urgently needed improvements would be a data-monitoring device that is significantly more sensitive or more efficient that the conventional fluorescent screen.
Author

N69-22864# California Univ., Berkeley. Lawrence Radiation Lab.
A CALCULATION OF THE PHYSICAL CHARACTERISTICS OF NEGATIVE PION BEAMS. ENERGY-LOSS DISTRIBUTION AND BRAGG CURVES
Stanley B. Curtis and Mudundi R. Raju *In its* Biol. and Med. 1967 p 108–122 refs Submitted for publication (See N69-22859 11-04)
(UCRL-17606) Avail: CFSTI

The physical properties of a stopping negative pion beam were studied in connection with dosimetry experiments with such beams at the 184-inch cyclotron. Calculations were made of the dE/dx distribution in the stopping pion region, and central-axis depth-dose curves (Bragg curves) were computed with the assumption of a uniform parallel incident beam with a large enough cross section so that multiple scattering could be neglected. A Gaussianly distributed incident momentum spread was assumed such that the width of the Bragg peak in the stopping region due to momentum straggling was large compared with range straggling effects. This approximated well the experimental situation. Although the calculations were carried out with water as the stopping medium, comparison of the resulting Bragg curve with an experimental curve obtained with a silicon detector showed good agreement.
Author (NSA)

N69-22865# California Univ., Berkeley. Lawrence Radiation Lab.
THE MEASUREMENT OF THE EFFECTS OF X-RAYS AND HELIUM IONS ON THE PROLIFERATIVE CAPACITY OF LYMPHOMA ASCITES TUMOR CELLS IN VIVO
Jose M. Feola, John H. Lawrence, and Graeme P. Welch *In its* Biol. and Med. 1967 p 151–165 refs (See N69-22859 11-04)
Avail: CFSTI

The oxygen enhancement ratio and the relative biological effectiveness of 910 MeV helium ions of various linear energy transfer were compared using the growth of transplanted ascites tumor cells in mice following X-irradiation in vitro as the test criteria. Seven days prior to irradiation, mice were injected with tumor cells. Thirty minutes before irradiation the animals were sacrificed and tumor cells in ascitic fluid were removed and irradiated in an atmosphere of either oxygen or nitrogen. A counted number of tumor cells was then injected into mice and the number of

tumors that developed during the next eight wks was recorded. Results are presented in graphs and tables and the value of the experimental procedure for measuring the net result of a number of radiation-initiated processes in cells is discussed. NSA

N69-22892# California Univ., Berkeley. Lawrence Radiation Lab.
AMINOACYLIC DERIVATIVES OF NUCLEOSIDES, NUCLEOTIDES AND POLYNUCLEOTIDES. 1. SYNTHESIS OF 3'(2')-O-AMINOACYLNUCLEOTIDES
A. A. Kraevskii, P. P. Purygin, L. N. Rutzite, Z. S. Belova, and B. P. Gottikh Sep. 1968 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 2, 1968 p 378–382
(PB-180884T; UCRL-TRANS-1380) Avail: CFSTI CSCL 07C

A new method was developed for the synthesis of 3'(2')-O-aminoacyl-nucleotides based on the condensation of nucleotides with imidazolides of N-tert. butyloxycarbonyl amino acids followed by removal of the tert. butyloxcarbonyl protection by processing with hydrogen chloride in abs. ether. (Author) USGRDR

N69-22894# School of Aerospace Medicine, Brooks AFB, Tex.
A SIMPLIFIED DETERMINATION OF URINARY TESTOSTERONE UTILIZING COLUMN AND GAS-LIQUID CHROMATOGRAPHY, JULY 1966-JULY 1968
J. Throck Watson and Michael Lofrano, Jr. Oct. 1968 15 p refs
(AD-681503; SAM-TR-68-117) Avail: CFSTI CSCL 6/1

A simplified and reliable assay for urinary testosterone has been established which requires only one purification by silica gel column chromatography prior to quantification by gas chromatography. The procedure avoids most of the enzyme-inhibiting debris in the urine by preliminary precipitation of the steroidal material with ammonium sulfate. Enzyme hydrolysis reaches near-maximum completion in 18 to 24 hours at 37C with only 10% the normal dosage of enzyme. Author (TAB)

N69-22956# Florida Univ., Gainesville.
COMPARISON OF THE RATE AND EXTENT OF DEOXYRIBONUCLEIC ACID REPAIR AND SEMI-CONSERVATIVE SYNTHESIS IN BACTERIA EXPOSED TO ULTRAVIOLET LIGHT
Daniel Billen 1 Aug. 1968 16 p Presented at the Symp. on the Effects of Radiation on Cellular Proliferation and Differentiation, Monaco, 1–6 Apr. 1968
(Contract AT(40-1)-3596)
(ORO-3596-7; CONF-680413-4) Avail: CFSTI

Using deuterium, ^{15}N, and ^{13}C as a density label and buoyant density centrifugation in CsCl as a means of separating pre- and post-irradiation synthesized DNA strands, the rate and extent of DNA repair synthesis in exponential-phase *Escherichia coli* strain B/r was determined. After uv exposure, ^{3}H-thymine incorporation into the "heavy" parental DNA strands was used to measure repair synthesis; while ^{3}H-thymine incorporation into "light" and newly synthesized DNA strands measured semi-conservative replication. Author (NSA)

N69-22978# Hebrew Univ., Jerusalem (Israel). Dept. of Physical Chemistry.
THE ACTION OF RADIATIONS ON SOME BIOLOGICAL MODEL SYSTEMS. Technical Progress Report, 1 Aug. 1967–15 Aug. 1968
Gabriel Stein 15 Aug. 1968 30 p refs
(Contract AT(30-1)-3242)
(NYO-3242-29) Avail: CFSTI

Excitation processes in irradiated systems under the influence of ionizing radiations were investigated. Excitation processes in aromatic systems were examined by studying the temperature dependence of γ-radioinduced trans → cis isomerization of stilbene in toluene. Excitation processes in x-irradiated aqueous solution of sodium salicylate, and the role of free radical processes in the action of ionizing radiation on aqueous solutions of biochemical and biological systems were also studied. A functional correlation between aromatic and divalent sulfur amino acids in ribonuclease was found in reactions with hydrogen atoms in aqueous solutions. NSA

N69-22995# Centre de Recherches Psychopathologique, Paris (France).
STUDY OF PSYCHOLOGICAL ATTITUDES OF NUCLEAR WORKERS TOWARDS RADIOACTIVITY RISK. Final Report [L ETUDE DES ATTITUDES PSYCHOLOGIQUES DES TRAVAILLEURS NUCLEAIRES VIS-A-VIS DU RISQUE RADIOACTIF. RAPPORT FINAL]
P. Sivadon and A. Fernandez Brussels 1968 161 p
(Contract EURATOM-002-62-10-PSTF)
Avail: CFSTI

The potential variety of psychological attitudes found among nuclear workers was studied, with stress on their origins and the motivations that change them, such as knowledge acquired, individual integration of safety measures, and influence of surroundings. Several methods of approach were necessary. These included: (1) analysis of personal histories and medico-psychological clinical examination; (2) analysis of responses to certain psychometric tests and personality projection tests; (3) analysis of psychological aspects connected with the job; and (4) a collective approach and study of the dynamics of the working parties and the social circles in which the worker was associated. The final attitudes were characterized by complexity and showed a shifting history. Knowledge of them is considered useful in improving adaptation to radioactive hazards and in obtaining the proper responses to changes in individual and collective safety conditions. Author

N69-23059# Atomic Energy Commission, Idaho Falls, Idaho. Health Services Lab.
APPLIED THERMOLUMINESCENCE DOSIMETRY PROGRAM AT THE NRTS
John P. Cusimano, Foster V. Cipperley, and John C. Colley *In its* 2d Intern. Conf. on Luminescence Dosimetry [1968] p 722–736 refs (See N69-23005 11-06)
Avail: CFSTI

Procedures for large scale personnel monitoring using thermoluminescent dosimetry are described and evaluated as a result of a two year program to study persons subjected to low background environmental exposure. It was found that gamma exposures in the low mR range can be measured on a routine basis using calcium fluoride–dysprosium extrusions, and data are presented from such measurements. Applications to a national health physics program, involving such subjects as finger and hand dosimetry, shielding measurements, radiation source calibration and thermoluminescent dosimetry for use by doctors and nurses handling radiation accident victims, are also discussed. In addition, the laboratory decontamination facility and shielded operating room are also described, as well as the potential of thermoluminescent methods and their advantages over existing methods and techniques of reactor measurement. Author

N69-23072# Leeds Univ. (England). Dept. of Medical Physics.
LiF THERMOLUMINESCENCE DOSIMETRY IN TRABECULAR BONE
G. D. Zanelli and F. W. Spiers *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 920–935 refs (See N69-23006 11-06)
Avail: CFSTI

The problems of dosimetry in trabecular bone are discussed with reference to the intricate structure of the bone. Results of experiments on human, dog and pig vertebrae using finely ground LiF, are given, and the results are compared with standard and new methods of calculation. It is shown that calculations based on the linear path method agree well with the experimental findings. Some phenomena relating to very fine LiF which came to light during the course of the experiments are also treated. Author

N69-23074# Jefferson Medical Coll., Philadelphia, Pa. Stein Research Center.
THE TOXICITY OF THERMOLUMINESCENT PHOSPHORS
C. M. Dettmer and B. M. Galkin. *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 944-950 refs (See N69-23005 11-06)
(Grant PHS CA-5109)
Avail: CFSTI

The toxic effects of thermoluminescent phosphors in rats were investigated by introducing these materials by ingestion, intraperitoneal insertion, and subcutaneous implantation. Ingestion of aqueous solutions of LiF proved fatal to 10 to 15 animals within four weeks. Gross symptoms of poisoning were reversed by allowing the animals to drink distilled water in place of the LiF solution. All of the phosphors tested produced adhesions when placed within the abdominal cavity. Subcutaneously implanted detectors caused local tissue reaction but did not appear to cause gross ill effects. Hot pressed and extruded forms of LiF were not recoverable 3 weeks after implantation. Author

N69-23077# Oak Ridge Associated Universities, Tenn.
PHANTOM DEPTH-DOSE MEASUREMENTS WITH EXTRUDED LiF IN A LOW-EXPOSURE RATE TOTAL BODY IRRADIATOR
W. L. Beck, E. L. Callis, and R. J. Cloutier. *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 976-989 refs (See N69-23005 11-06)
Avail: CFSTI

Extruded LiF dosimeters were used to measure the depth-dose distribution in a heterogeneous human-like phantom irradiated in the new low exposure rate total-body irradiator. In addition to the problems generally encountered in making such measurements, the nature of this irradiator posed several new ones because of its low exposure rate, large exposure volume, and multidirectional exposure pattern. To make depth-dose measurements in such a facility, a dosimetry system must be sensitive to small exposures, directionally independent, energy independent, and precise. Extruded LiF dosimeters were found to be well suited for this study. Techniques were worked out for handling, annealing, identifying, and individually calibrating these dosimeters. With these techniques, exposure measurements having standard deviations of about 1% are generally obtained. Isodose lines were determined from the point depth-dose measurements in the midlongitudinal and the midsagittal planes of the phantom. These lines show that the depth dose to the back region of the body is somewhat lower than near the front surface. Author

N69-23078# Jefferson Medical Coll., Philadelphia, Pa. Div. of Radiation Therapy.
THREE DIMENSIONAL DOSE DISTRIBUTION MEASUREMENTS IN THE HEAD AND NECK USING LiF
C. M. Mansfield, B. M. Galkin, M. C. Chow, and N. Suntharalingam. *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 990-999 refs (See N69-23005 11-06)
Avail: CFSTI

Lithium fluoride powder and extrusions were used in a phantom head to measure dose distributions from typical Cobalt-60 teletherapy techniques. Measured doses in the central treatment plane have been compared with calculated values. Volume dose distributions have been determined. The reliability of thermoluminescent dosimetry for clinical applications has been demonstrated. Author

N69-23126*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Mar. 1969 138 p refs
(NASA-SP-7011/61/) Avail: CFSTI CSCL 05B

Subject coverge concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. Author

N69-23138*# National Aeronautics and Space Administration, Washington, D. C.
BIOSATELLITE 2
1969 12 p
(NASA Facts 3/10-68) Avail: SOD $0.35 CSCL 06S

Frog eggs, microorganisms, plants, and insects were launched in Biosatellite 2 and orbited for two days. The purpose of the flight was to determine the effects on living things of weightlessness, weightlessness combined with radiation, and removal from the diurnal cycle on earth. Comparisons of the life processes of these plants and animals were made with the life processes of normal plants and animals on earth. Mutations and abnormalities in the Biosatellite plants and animals are explained. B.G.D.

N69-23198*# Naval Aerospace Medical Inst., Pensacola, Fla. Bureau of Medicine and Surgery.
NUCLEAR EMULSION MEASUREMENTS OF THE ASTRONAUTS' RADIATION EXPOSURE ON APOLLO 7
Herman J. Schaefer and Jeremiah J. Sullivan 13 Feb. 1969 15 p refs Supported by NASA
(NASA-CR-100645; NAMI-1060) Avail: CFSTI CSCL 06R

Preliminary results are presented in order to establish a comparative base line for radiation exposure of astronauts in conventional near-earth satellite orbits with the deep space trajectories of later Apollo flights. Such a comparison is of particular interest due to the fact that the Apollo mission made only two very rapid passes through more peripheral regions of the inner radiation belt and avoided the repeated traversals of the South Atlantic anomaly, which accounted for more than 90% of the dose on all Gemini flights. In addition, the Apollo trajectory was nearly outside the magnetosphere, allowing exposure to the full galactic flux with no geomagnetic cutoff, at 4 pi incidence on the ship for most of the mission. Track and grain count analysis of only one of the three G.5 emulsion packs furnished a dose of 122 mrad; the LET distribution was nearly identical to one recorded by Gemini 7. Proton ender counts in all packs showed more uniformity in directional distribution than those on Gemini 7, presumably caused by heavier shielding. A.C.R.

N69-23329# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
THE STRUCTURE AND SYMMETRY OF VIRUS PARTICLES [ARCHITETTURA E SIMMETRIA DELLE PARTICELLE VIRALI]
M. Ageno 18 Oct. 1968 59 p refs in ITALIAN; ENGLISH summary
(ISS-68/37) Avail: CFSTI

Current ideas on the structure of virus particles and the physical principles which underlie the assembly process of protein and nucleic acid components are presented. The validity of these ideas is discussed and the conclusions which might be drawn from the available experimental evidence are considered. Author

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-22008 Arizona Univ., Tucson.
TACTILE PERCEPTION OF ELECTRONICALLY TRANSFORMED AUDITORY SPECTRA
Lorin Post McRae (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-13675

Tactile communications and efforts at alternate sensory input of auditory type signals have been reviewed. A tentative approach to communication for the deaf has been selected. That part of the approach concerned with the electronic transformation of speech prior to presentation at the interface with the tactile nervous system has been chosen for particular consideration. Tests have been conducted to determine the number of constant-frequency, amplitude varying stimulators required if sufficient information is to be presented at the tactile interface to conceivably allow for adequate speech recognition. The normal hearing process was used for recognition tests. The exact transformed signals to the tactile nervous system were used to resynthesize auditory signals with some resemblance to speech. A variety of filtering systems was evaluated under varying conditions. Procedures are outlined for greater optimization of the filtering systems and electronic transformations. Research is proposed for extending the models and procedures. A model of the speech recognition process is proposed with direct implications of the urgent need for a portable working model of a tactile communication system to evaluate the adaptive capacity of the tactile nervous system. Dissert. Abstr.

N69-22198*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
DEVELOPMENT OF A VERSATILE SYSTEM FOR DETAILED STUDIES OF THE PERFORMANCE OF HEAT PIPES
J. H. Streckert and J. C. Chato Dec. 1968 49 p refs
(Grant NGR-14-005-103)
(NASA-CR-100725; ME-TR-64) Avail: CFSTI CSCL 17Q

A heat pipe with variable dimensions was designed for the study of steady state and transient heat pipe performance using different fluids and wicking materials. An open ended dewar was designed and constructed for housing the heat pipe system. The maximum length of wicking material was 82 cm; this distance was considered the maximum length of heat transfer required in future space suits. Distilled water was the transfer medium used in the wicking chamber. The heat input to the dewar was supplied by electric heaters. Circulation of cool water was used to remove heat from the condenser end of the dewar. Approximately 45 thermocouple points were used for measuring important temperatures in the system. Throughout the entire wicking chamber, a maximum temperature variation of ±1/2°C was encountered during normal heat pipe operation. No transient temperature lag from one end of the wicking chamber to the other end was observed during heat input changes. Apparently the time constants of the heat input changes were much larger than the temperature equalizing time constant of the wicking chamber. Author

N69-22225*# Techtran Corp., Glen Burnie, Md.
HUMAN ENGINEERING INVESTIGATION OF F-104J COCKPIT BY QUESTIONNAIRE
Hiroko Hagihara et al Washington NASA Apr. 1969 23 p refs Transl. into ENGLISH from Japan Air Self Defense Force, Aeromedical Lab. (Japan), v. 8, Sep. 1967 p 1–12
(Contract NASw-1695)
(NASA-TT-F-12137) Avail: CFSTI CSCL 06B

A human factors engineering investigation was completed on 462 pilots, concerning input and output systems, in the cockpit arrangements of the F-104J aircraft. Findings were: (1) Indicators of instrument panel and arrangement of instrument in F-104J aircraft were superior to those in old type aircrafts. (2) Diameter of hyd. oil pressure gauge was too small and cabin pressure altimeter, stand-by compass and accelerometer were not appropriately arranged. (3) Bearing distance heading indicator, hyd. oil pressure meter and cabin altimeter have poor instrument lighting. (4) Warning system in F-104J aircraft was better than all old types, but legends were too small to read quickly. (5) SIF, heater control panel, light control, AARS, both circuit breakers were considered inconvenient in legibility, controlling and lighting. (6) The radar panel is not well designed for manipulations. Author

N69-22272# School of Aerospace Medicine, Brooks AFB, Tex.
PSYCHIATRIC STRENGTHS AND WEAKNESSES OF TYPICAL AIR FORCE PILOTS, SEPTEMBER 1965–MARCH 1967
Paul M. Fine and Bryce O. Hartman Nov. 1968 44 p
(AD-681495; SAM-TR-68-121) Avail: CFSTI CSCL 5/10

Fifty pilots were selected at random from a larger group of 250 aircrewmen who participated in research on intensive medical evaluations. Test scores and other data from a comprehensive psychologic test battery and a background questionnaire were analyzed and integrated to yield a picture of the personality structure of the modal military pilot. Author (TAB)

N69-22648# California Univ., Berkeley. Lawrence Radiation Lab.
APPLICATION OF ELECTRON DIFFRACTION TO PROBLEMS IN BIOLOGICAL ELECTRON MICROSCOPY
R. M. Glaeser, G. Thomas, R. Cristensen, and W. G. Brammer (Picker Nucl., White Plains, N. Y.) 12 Jun. 1968 5 p ref Submitted for publication Supported in part by PHS
(Contract W-7405-eng-48)
(UCRL-18293; Conf-680905-1) Avail: CFSTI

The application of selected area diffraction, dark field imaging, and low-angle Fourier contrast to biological materials is discussed. NSA

N69-22755# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
MONOMETHYLHYDRAZINE (MMH) ABSORBING CAPACITY AND INDICATOR EFFICIENCY OF THE MSA ROCKET PROPELLANT CANISTER GMN-SSW Final Report, Sep.–Dec. 1967
Eugene L. Arnold Jul. 1968 22 p refs
(AD-682299; AMRL-TR-68-35) Avail: CFSTI CSCL 6/17

A rocket propellant gas mask canister was tested to determine its effectiveness in removing monomethylhydrazine (MMH) from an airstream. The accuracy of the window indicator incorporated in this canister was also evaluated for MMH exposures. Six canisters were tested in the study. A flow rate of 50 liters/min and concentrations of MMH in air of from 30 to 1200 ppm were used. The effects of both continuous and intermittent exposures were determined. Author (TAB)

N69-22762# Battis Atomic Power Lab., West Mifflin, Pa.
MEANS OF DETECTING AND PROTECTING AGAINST TRITIUM
Yves Sutra-Fourcade Dec. 1967 100 p refs Transl. into ENGLISH from the French Rept. CEA-R-3350
(WAPD-Trans-102; CEA-R-3350) Avail: CFSTI

An attempt to correlate present data concerning tritium, especially from the health physics points of view, is presented. The various detection and measurement methods are reviewed in turn: measurement of tritium in the atmosphere, in liquids, and on surfaces. The operation of various types of apparatus is analyzed, and the sensitivity limits deduced from laboratory tests are given. Other sections are devoted to the means of protection which can be used against inhalation of tritium (ventilation, protective clothing) and to calculations of the changes in atmospheric pollution in a given place and of the time spent in a contaminated zone. The last part deals with the decontamination of equipment contaminated with tritium. Author (NSA)

N69-22766*# Battelle Memorial Inst., Columbus, Ohio.
SYSTEMS APPROACH TO EVALUATING HYDROGENOMONAS CULTURES
John F. Foster and John H. Litchfield Washington NASA Apr. 1969 48 p refs
(Contract NAS2-4270)
(NASA-CR-1296) Avail: CFSTI CSCL 06M

Cultures of *Hydrogenomonas eutropha* are confirmed as a stable process operating at room temperature for waste conversion, to consume the metabolic wastes carbon dioxide and urea; and the hydrogen by-product from water electrolysis. Environmental measurements with feedback controls can balance consumption of these wastes by individual makeups at the same rates as consumption. In this manner, a stable culture with constant conversion rates can be maintained in steady state growth for long periods and is suitable for consideration as a continuous waste conversion process. The growth rate indicated by careful experimental measurements is a fractional increase of 0.33 per hour of the weight of bacterial cells in the culture, which is harvested continuously from a cellular culture maintained at a constant concentration of 6.1 g (dry weight) per liter of liquid culture. These values can be used for calculating the maximum production rate of cellular material in evaluating potential practical applications. Author

N69-22789# System Development Corp., Santa Monica, Calif.
LINGUISTIC AND TUTORIAL MODELING FOR NATURAL LANGUAGE CAI
F. D. Bennik, R. M. Schwarcz, and H. F. Silberman Dec. 1968 16 p refs
(Contract F33815-68-C-1473)
(AD-681530; SDC-SP-3260) Avail: CFSTI CSCL 5/9

The paper describes research that has as its goal the development of a computer-based tutorial system that can recognize and generate natural English discourse, while providing CAI lesson authors with a meaningful means of lesson preparation. The primary line of research concentrates on natural language data processing and conceptual modeling designed to support a CAI system. This has resulted in computer programs that perform functional operations of syntactic and semantic analysis, inferring answers to questions, generation of coherent discourse, and recognition and generation of paraphrase. A second line of research was initiated to find decision rules for generating and sequencing remedial questions and statements. From a study of verbal data obtained from the recorded messages of tutors, as they monitor and augment the interaction between students and a computer-administered lesson, a set of effective decision rules is sought that can invoke computer generation of remedial feedback from a subject matter data base. Author (TAB)

N69-22990*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
THE RELATIONSHIP BETWEEN OPTICAL DISTORTION AND BINOCULAR DEPTH PERCEPTION
L. R. Loper and R. C. Stout Washington Apr. 1969 10 p refs
(NASA-TN-D-5162) Avail: CFSTI CSCL 06B

Binocular depth perception, a vital function during spacecraft docking and lunar landing, could be degraded by any spacecraft system optical transparency. A study of the relationship between binocular depth perception and optical distortion in the Apollo pressure suit helmets and visors was made to aid in setting optical distortion limits for the helmets and visors. Data obtained from the study indicated that all the helmets and visors which were tested degraded binocular depth perception. As measured by the Howard–Dolman apparatus, there is evidently a systematic effect of optical distortion in the Apollo helmets and visors on binocular stereoscopic depth perception. A program for studying this problem in greater depth is outlined. Author

N69-23063# Kernforschungszentrum, Karlsruhe (West Germany)
PHOSPHATE GLASS DOSIMETERS FOR THE MEASUREMENT OF ORGAN DOSES WITH REDUCED BODY INFLUENCE
Ernst Piesch *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 783–806 refs (See N69-23005 11-06)
Avail: CFSTI

Based on radiation dosage as a function of quantum energy in a given organ at an exposure of 1 R, energy compensation filters for phosphate glasses were developed. These dose readings showed the same energy dependence as the absorbed dose in the critical organ, such as gonads, bone marrow, gastrointestinal tract, and lenses of the eyes. Two possibilities of organ dose indication at the front side of an Alderson phantom were realized: (1) The dosimeter reading is energy independent, at least, for radiation incidence on the front side of the phantom. (2) The dosimeter reading is energy independent for radiation incidence from the front and likewise from behind the phantom. Phosphate glass dosimeters are described directly indicating the absorbed dose in critical organs with reduced influence of body orientation to radiation incidence for quantum energies above 50 keV. For the other organs or for lower quantum energies, detailed statements about radiation quality and radiation incidence were found to be required. Here, the depth dose distribution in phosphate glasses, which can be measured by employing a multiscanning technique, offers the additional advantage of indicating the dose actually absorbed in the body. Author

N69-23064# Isotopes, Inc., Westwood, N. J.
A THERMOLUMINESCENCE PERSONNEL DOSIMETRY BADGE
Douglas Jones and Geoffrey Webb *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 807–813 refs (See N69-23005 11-06)
Avail: CFSTI

Since standard definition of maximum permissible exposures are specific to critical body sites, such as skin, gonads, and bone marrow, a badge designed to directly measure the dosage at these organs is described. The relationship between the exposure at the chest wall, which is the normal position for a badge dosimeter, and the dose delivered to the critical sites for various photon energies was previously measured. Based on these values, a material which is approximately tissue equivalent, LiF-Teflon, was used for the badge, and the response was modified by using the appropriate filters to simulate the critical organs. A physical description of the badge is given, as well as the form of information retrieved from it and the routine procedure for its use within a complete thermoluminescence dosimetry system. Author

N69-23111*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Biotechnology and Power Dept.
PARAMETRIC STUDY OF MANNED LIFE SUPPORT SYSTEMS. VOLUME 1: SUMMARY Final Report, Jul. 1967–Aug. 1968
R. S. Barker Jan. 1969 23 p
(Contract NAS2-4443)
(NASA-CR-73282; DAC-56712-Vol-1) Avail: CFSTI CSCL 06K

New analytical tools and a computer program were developed for conducting life support system tradeoffs from a mission analysis standpoint. The scaling laws and characteristics developed for each of many life support system functional methods were confirmed with equipment data obtained from the latest literature and through a vendor survey. The computer program developed can be used to describe and characterize a variety of life support systems. These systems can be identified with respect to such mission analysis variables as mission flight path, mission duration, and crew size, and they can be characterized with respect to life support system variables such as ecological closure and selected types of equipment for performing particular functions. Emergency and spares provisions are determined. Vehicle interactions such as those involving meteoroid and radiation shieldings, electrical power systems, and equipment heat sources can also be computed. The results are given in sufficient depth to provide the spacecraft designer with all the necessary data for sizing and locating the life support system within the vehicle. Provided also are data which define the interfaces of the life support subsystems with interrelated vehicle systems. Author

N69-23112*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Biotechnology and Power Dept.
PARAMETRIC STUDY OF MANNED LIFE SUPPORT SYSTEMS. VOLUME 2: PARAMETRIC RELATIONS AND SCALING LAW Final Report, Jul. 1967–Aug. 1968
M. M. Yakut and R. S. Barker Jan. 1969 388 p refs
(Contract NAS2-4443)
(NASA-CR-73283; DAC-56713-Vol-2) Avail: CFSTI CSCL 06K

Parametric data were prepared for various functional methods involved in defining, describing, and characterizing the life support subsystems. Empirical, analytical, and engineering design techniques were used in obtaining these relations. Sensitivity analyses were performed during the development period to ensure the applicability of the study results to mission analysis studies and to life support system definition and subsystem tradeoff studies. Individual parametric relations, scaling laws, and analytical relationships developed for the component elements and for the eight life support subsystems are presented in terms of equipment weight, volume, size, and required electrical power, cooling, and heating. Author

N69-23113*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Advance Biotechnology and Power Dept.
PARAMETRIC STUDY OF MANNED LIFE SUPPORT SYSTEMS. VOLUME 3: COMPUTATIONAL PROCEDURES Final Report, Jul. 1967–Aug. 1968
R. S. Barker Jan. 1969 97 p refs
(Contract NAS2-4443)
(NASA-CR-73284; DAC-56714-Vol-3) Avail: CFSTI CSCL 06K

The intent is to present the scope of the objectives in enough detail to facilitate evaluations of the sophistication of the mathematical models used for life support subsystems and of the capabilities and limitations of the developed computer program. The computer program is described in terms of the input data loadsheets, the computational logic, the output data formats, and special program features. Sample problem specifications and plotted and tabulated computer output data are also presented. Sensitivity evaluations and other observations derived from the output data are included with the discussion of the sample problem results. Through use of computational logic diagrams presented herein, in conjunction with parametric data and subsystem and component details presented in Volume II, hand calculations can be performed. Author

N69-23192*# Whirlpool Corp., St. Joseph, Mich.
RELIEF CONTAINER
George W. Priebe and Francis R. Scroop, inventors to NASA
Issued 14 Jan. 1969 (Filed 26 Aug. 1966) 4 p Cl. 128–283
(NASA-Case-XMS-6761; US-Patent-3,421,506; US-Patent-Appl-SN-575475) Avail: US Patent Office

A relief container or colostomy appliance is described. It is intended for use by persons who must remain in confined quarters for relatively long periods of time, for example, astronauts during spaceflight who have need of a relief container which can be used sanitarily and effectively without escape of odors and contents, and which is also adaptable to storage while using very little storage space. It may also be used as a colostomy appliance by patients who have need of a drainage collection appliance. The novelty of the apparatus lies primarily in the finger stall in the side of the collection bag which serves as an aid to the user in locating the bag in its proper position on the body; the outer cuff-like container which serves as a receptacle for cleansing tissue and is provided with adhesive pads whereby it serves as a compact packaging device for the unit; and the particular combination of components including the collection bag, pressure-sensitive adhesive means, finger stall, and outer container. (NASA)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N69-21952 Purdue Univ., Lafayette, Ind.
REACTIVE INTERMEDIATES IN ORGANOSILICON CHEMISTRY
Thomas J. Pullukat (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12603

The reaction of dichloromethyltrimethylsilane with lithium was studied in tetrahydrofuran and in a hydrocarbon solvent as a means to generate silicon containing carbenes. Partial desulfurization of a silicon containing trithiocarbonate also was studied as a route to a carbene containing silicon. Organosilicon compounds containing nitrogen in a divalent state like hydrazides and in a monovalent state like nitrenes were investigated. The decomposition modes of tris-trimethylsilyl-methyl-boron and aluminum also were studied. Dissert. Abstr.

N69-21975 South Carolina Univ., Columbia.
ELECTRON SPIN RESONANCE STUDIES OF POLYCYCLIC HYDROCARBON MOLECULES
Oscar Franklyn Griffith, III 1968 183 p
Avail: Univ. Microfilms: HC $8.70/Microfilm $3.00 Order No. 68-9774

The ESR studies of the hyperfine splitting of an unpaired electronic spin in the π electron system of a polycyclic hydrocarbon are used to infer charge of spin densities at the molecular carbon sites. These unpaired spins interact through a configuration coupling with the edge protons. The radical ions were generated in a solution contained in an electrolytic cell designed to be used in the spectrometer cavity and oxygen was 41.90°K, by vacuum techniques. Data was taken with a spectrometer while the samples were at room temperature. The spectrum from 1,2 benzpyrene yielded coupling constants of 4.55, 2.25, 4.23, 0.73 and 0.90 gauss. Results from a 3,4 benzphenanthrene solution were 4.05, 0.54, 1.36, 1.95, 2.46 and 0.22 gauss. Chrysene results were somewhat ambiguous but the proposed analysis yielded 0.23, 0.25, 1.36, 2.04, 1.14 and 3.42 gauss as coupling constants. Dissert. Abstr.

N69-21978 California Univ., Davis.
LANTHANIDE COMPLEXATION REACTIONS
Herbert Bruce Silber (Ph.D. Thesis) 1968 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-12372

The kinetics of lanthanide ion complexation with o-aminobenzoic acid (anthranilic acid) in aqueous sodium perchlorate were studied using the temperature-jump relaxation technique. Second-order rate constants corresponding to the reaction between the aquated rare earth ion and the o-aminobenzoate ion and the first-order rate constants for the reverse process were determined. Activation parameters were obtained. Corresponding experiments were carried out in D_2O and pertinent activation parameters were determined. Differences in the bimolecular rate constants and activation parameters in H_2O and the comparison of these values with corresponding values obtained in D_2O give information concerning both the structure of the aquated rare earth ion and the mechanism for the complexation reaction. Dissert. Abstr.

N69-21987 Rutgers Univ., New Brunswick, N. J.
HIGH LEAD FERRITES
Michael Tokar, Jr. (Ph.D. Thesis) 1968 306 p
Avail: Univ. Microfilms: HC $13.95/Microfilm $3.95 Order No. 68-14275

This research was concerned with an effort to provide a permanent magnet lead ferrite material having magnetic properties superior to comparable materials presently available, such as the barium and strontium ferrites. Optimization of magnetic properties was sought through proper selection and control of various processing parameters such as raw materials, firing cycles, furnace atmospheres, binders and lubricants, comminution methods, and composition. Polycrystalline isotropic lead ferrite specimens were prepared by calcining (prereacting) and sintering techniques. A detailed study of the PbO–Fe_2O_3 system showed that specimens having an initial composition of $PbO \cdot 5Fe_2O_3$ had the best permanent magnet properties (for non-doped material). The effects of small (usually 1 wt % or less) amounts of certain oxides on the magnetic properties, on the PbO loss (due to volatilization during firing) and on densification of the pressed compacts were also investigated. Dissert. Abstr.

N69-22001 Michigan Univ., Ann Arbor.
VOLTAMMETRIC STUDIES OF OXYGEN, HYDROGEN ION AND THE ELECTRODE SURFACE OF THE PYROLYTIC GRAPHITE ELECTRODE IN AQUEOUS SOLUTIONS OF POTASSIUM CHLORIDE
Murray Rosen (Ph.D. Thesis) 1968 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-13392

The purpose was to characterize pyrolytic graphite as material for an indicating electrode. The prepared electrode, in which the graphite was used without any pretreatment and was oriented with the ab plane parallel to the exposed surface, was studied in preelectrolyzed aqueous potassium chloride solutions, employing voltammetric methodology (0.1 v./sec.). A cyclic voltammogram taken in background solution alone shows (at all potentials between the positive and negative potential limits set by the discharge of cationic and anionic species) faradaic current from three processes; these are associated with the presence of surface film composed of oxygenated intermediates, formed by the action of the applied potential sweep between 0.8 and −1.6 v. (S.C.E.) on adsorbed water and its pH-equilibrium species. Dissert. Abstr.

N69-22004 California Univ., Los Angeles.
A STUDY OF THE ELECTROCHEMICAL BEHAVIOR OF IRON BY THE ROTATING DISK TECHNIQUE
Robert Fred Tobias (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-11885

The electrochemical behavior was examined of Ferrous E iron in deaerated acid media in the absence and presence of several reducible species whose reaction rates were diffusion limited. A rotating disk electrode was employed to control the mass transfer to the electrode surface. Results showed that in 1N H_2SO_4 solutions the angular velocity of the disk had no effect on the corrosion potential, the anodic Tafel or cathodic Tafel regions. The corrosion potential was -498 ± 8 mv with a corrosion current of approximately 2×10^{-4} A/cm^2. From galvanostatic polarization curves the Tafel slopes for iron dissolution and for hydrogen evolution reaction were 41 ± 3 mv and 116 ± 8 mv, respectively. The reduction of ferric ions (1.26 to 25.2 mM) in $\leq$ 1N H_2SO_4 occurred at limiting diffusion rates. The corrosion potential of iron in 1N H_2SO_4 containing ferric ions relative to the corrosion potential of iron in the absence of ferric ions, ΔE_c, varied with the ferric ion concentration and the disk angular velocity. Dissert. Abstr.

N69-22005 Iowa State Univ. of Science and Technology, Ames.
DECOMPOSITION AND HYDROGENATION STUDIES OF SIMPLE HYDROCARBONS ON TUNGSTEN
Robert Ray Rye (Ph.D. Thesis) 1968 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-14819

Ultrahigh vacuum techniques have been combined with flash filament spectroscopy and rapid scan mass spectroscopy in order to study the surface reactions of simple hydrocarbons on tungsten. Admission of ethylene to a hydrogen covered surface at 300°K results in essentially instantaneous conversion to ethane in an amount corresponding to approximately 1/10th of an ethylene monolayer. The surface is thereafter poisoned for rapid hydrogenation. Admission of ethylene on a clean tungsten surface again results in a rapid conversion to ethane but with a short induction period during which only ethylene is observed in the gas phase. Comparison of the results on tungsten with results obtained on iridium indicates that stability of surface ethylene is a critical factor in hydrogenation rates. The stability of surface ethylene is discussed in terms of the possible structures of adsorbed ethylene imposed by the topography of the surface. Dissert. Abstr.

N69-22010 Cornell Univ., Ithaca, N. Y.
THE STARK EFFECT ON THE RELAXED EXCITED STATES OF THE F CENTER
Larry Duane Bogan (Ph.D. Thesis) 1968 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-11615

A phase sensitive detection system was used in conjunction with an applied ac electric field of 5 to 50 kV/cm (zero to peak) to detect small induced changes of less than 1% in the F center luminescence. Quadratic Stark effects were observed for the F center in KCl, KF, NaF, RbCl, and NaCl. The effects were qualitatively the same in all these alkali halides and consisted of an induced polarization of about 1% and a red shift of about 0.2 meV of the emission band at an RMS field strength of 30 kV/cm. In KCl and RbCl there was some indication of an induced broadening of the band. Between 2° and 50°K these effects are independent of the temperature but at higher temperatures the polarization and broadening decrease to zero. The polarization has been analyzed and shown to be an increase of the intensity of the emission polarized parallel to the direction of the applied field of twice the magnitude of the decrease in the intensity polarized perpendicular to the field.
Dissert. Abstr.

N69-22042 Purdue Univ., Lafayette, Ind.
SOME STUDIES OF METAL TO METAL BONDING OF GROUP IVB
John Kenneth Wittle (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12640

The amine catalyzed disproportionation of hexachlorodigermane was studied and found to yield germanium tetrachloride and polymeric materials approaching $(GeCl_2)x$ in composition. The treatment of trimethylsilylimidazole with silicon tetrachloride produced trimethylchlorosilane and a white solid which was identified as dichlorodiimidazolysilane. The analogous reaction with germanium tetrachloride produced trimethylchlorosilane and a white solid which approached the composition of the mixed complex trimethylsilylimidazole: trichlorogermylimidazole. Novel compounds, $(Cl_3PPtSiCl_3)_x$ and $(Cl_3PPtGeCl_3)_x$, have been prepared by the treatment of $(Cl_3PPtCl)_2$ with trichlorosilane and trichlorogermane.
Dissert. Abstr.

N69-22062 Georgetown Univ., Washington, D. C.
HETEROPOLY BLUES PREPARED FROM 12-TUNGSTATES: ELECTROCHEMISTRY, SPECTRA, AND SOME MAGNETIC PROPERTIES
Gideon Michael Varga, Jr. (Ph.D. Thesis) 1967 222 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-12813

The formation and properties of "heteropoly blues" prepared from 12-tungstates possessing the Keggin structure have been studied. Specifically involved was the establishment of reduction characteristics of a series of polytungstates and the measurement of certain properties of the blues by physical methods to give information regarding the nature of the bonding in the reduced species. The polytungstates investigated were: 12-tungstophosphate $[PW_{12}O_{40}]^{3-}$; 12-tungstosilicate, $[SiW_{12}O_{40}]^{4-}$; 12-tungstoferrate (III), $[FeW_{12}O_{40}]^{-5}$; 12-tungstocobaltate (II), $[CoW_{12}O_{40}]^{6-}$ and metatungstate, $[H_2W_{12}O_{40}]^{6-}$. One and two-electron reduction stoichiometry was established for these anions using polarography and potentiometric titrations. The polarographic half-wave potentials of polytungstates with more negative charge were observed to be pH dependent. The range of pH dependence of the various anions studied indicated that those polytungstates of greatest charge were the strongest Bronsted bases. The reduction potentials of the polytungstate series were largely a function of anionic charge and depended minimally on the nature of the central atom.
Dissert. Abstr.

N69-22078 Delaware Univ., Newark.
MASS TRANSFER DURING BUBBLE FORMATION ON A SIEVE TRAY
William Herbert Slack, Jr. (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-13168

The evaporation of n-butanol by nitrogen gas was studied at temperatures and pressures slightly above normal atmospheric conditions. Special equipment, involving probes on a sieve tray, was designed and constructed so that the gas residence time within the froth could be changed without seriously altering the froth structure. By changing the gas residence time while maintaining the froth height and system properties constant, the mass transfer rate and thus the efficiency during bubble formation could be obtained as an end effect. Penetration and boundary layer models were developed to predict the efficiency of the mass transfer during bubble formation. By using the results calculated from both theories, lower bounds on the average effective element width and thickness which controlled the mass transfer rate could be obtained.
Dissert. Abstr.

N69-22084 Pittsburgh Univ., Pa.
A GENERAL ANALYSIS OF MULTICOMPONENT MASS TRANSFER WITH SIMULTANEOUS REVERSIBLE CHEMICAL REACTIONS IN MULTIPHASE SYSTEMS
Lazarus Lasky Tavlarides (Ph.D. Thesis) 1968 212 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-14179

A general analysis is presented for describing the dynamics of multicomponent mass transport with simultaneous reversible or irreversible first-order chemical reactions in particulate systems consisting of large numbers of drops, bubbles or solid particles with residence time and particle size distributions. The method of approach and the general formulations are demonstrated by using matrix notation and appropriate transformations. The resulting partial differential equations for multicomponent, multiphase systems are first decoupled and then transformed into ordinary differential equations by employing an integral operator whose kernel takes into account the residence time distributions. Interaction among neighbor particles are taken into account by appropriate boundary conditions corresponding to an ensemble of spherical cell models.
Dissert. Abstr.

N69-22087 Colorado Univ., Boulder.
UNSTEADY-STATE DIFFUSION IN POROUS MEDIA
Paul William Allen (Ph.D. Thesis) 1968 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-14224

The purpose of this thesis was to investigate the use of an unsteady-state technique for the measurement of effective diffusion coefficients of gases in porous solids. An apparatus for the measurement of the pressure transient during the unsteady-state diffusion was designed and constructed and a method was developed for calculating diffusion coefficients from the experimental data. Five commercial materials, each with a different pore structure, were studied. Two of the solids were alumina catalysts, two were activated carbons, and the fifth was a silica-alumina catalyst. The diffusing species chosen were pure, single-component gases. Helium methane, nitrogen and krypton gases were run in all five porous solids and carbon monoxide and carbon dioxide gases were also used with the activated carbons. The runs were made at room temperature (23°C) and in two different pressure regions (approximately 50 mm. mercury and 150 to 230 mm. mercury).
Dissert. Abstr.

N69-22100 Ohio State Univ., Columbus.
THIXOTROPIC BEHAVIOR OF A COLLOIDAL SUSPENSION
Lloyd Garner Jones (Ph.D. Thesis) 1968 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-12847

A series of experiments were performed on a thixotropic non-Newtonian liquid suspension of colloidal alumina in propylene glycol. The liquid was designed so that set internal structural levels could be produced and viscometric data could be obtained in the absence of structural change. In addition to the structure curves obtained in this manner, the equilibrium curve, rates of change of viscosity at constant shear rates when the internal structure is initially completely built up, and rates of change of viscosity at various constant shear rates for numerous other structural levels were determined. Among the most important experimental findings were: (1) at a single structural level the liquid is non-Newtonian; (2) there is a different yield value associated with each structural level; (3) factors which affect results at one shear rate are not necessarily important at greatly different shear rates; and (4) the liquid has an elastic component when structure is present throughout the liquid. Dissert. Abstr.

N69-22108 Arizona Univ., Tuscon.
EXPLICATION OF RATE PHENOMENA IN CATALYTIC SYSTEMS
Joseph Edward Flanagan (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-14909

Modern digital computing techniques now allow a more comprehensive analysis of chemical reaction kinetic data through the use of kinetic models wherein fewer a priori assumptions are made concerning the relative importance of individual rate factors. Herein as described an approach to the development of kinetic models and a digitally implemented search technique for assessing the adequacies of postulated models. The search technique applies to nonlinear, implicit kinetic rate equations and consists of a two part procedure wherein the initial search is accomplished by steepest ascent followed by a modified Gauss-Newton nonlinear estimation procedure. Dissert. Abstr.

N69-22117 Purdue Univ., Lafayette, Ind.
FORMATION OF SILYL RADICALS
James Dale Reedy (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12606

The vapor phase, mercury-sensitized photocoupling of silanes results in disilane formation. Dimethylchlorosilane was coupled to give two disilanes, 1,2-dichloro-1,1,2,2-tetramethyldisilane (92%), and 1-chloro-1,1,2,2-tetramethyldisilane (8%). The latter disilane was removed by treating the mixed disilanes with chlorine at room temperature. Methyldichlorosilane under similar conditions yielded 1,1,2,2-tetrachloro-1,2-dimethyldisilane (88%) and 1,1,2-trichloro-1,2-dimethyldisilane (12%). Treatment of this mixture with chlorine at 70° completely removed the 12% component. Trichlorosilane also can be coupled to produce hexachlorodisilane (85%) and pentachlorodisilane (15%). Pure hexachlorodisilane can be prepared by treatment of this mixture with chlorine at 105°. Silicon tetrachloride displayed little reactivity under similar photolytic conditions. A solid which formed in this reaction appeared to be silicon metal. Dissert. Abstr.

N69-22122 Wisconsin Univ., Madison.
DIFFUSION AND PERMEATION OF GASES IN AMORPHOUS POLYMERS
Willard Anthony Geiszler, Jr. (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-10910

A cell for measuring the diffusion and permeation coefficients of gases in polymers by the time-lag technique was developed. The cell was used to measure the diffusivities and permeabilities of helium, neon, argon, and nitrogen in three butadiene-acrylonitrile copolymers. The activation energies for diffusion and permeation in the gas-polymer systems investigated were determined from the experimental data. The diffusional jump length was calculated from a comparison of the activation energies determined from the experimental data with a theoretical expression for the activation energy. A possible explanation of the change in activation of polymer systems energy is offered. Dissert. Abstr.

N69-22124 Oregon State Univ., Corvallis.
AN INVESTIGATION OF THE CRYSTAL GROWTH OF THE HEAVY METAL SULFIDES IN SUPERCRITICAL HYDROGEN SULFIDE
Leroy Crawford Lewis (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-11915

The results were compared with earlier work and with a theoretical result based on Raoult's Law. A relative order for the solubilities of sulfur and the sulfides of tin, lead, mercury, iron, zinc, antimony, arsenic, silver, and cadmium was determined and found to agree with the theoretical result. Hydrogen sulfide is a strong enough oxidizing agent to oxidize stannous sulfide to stannic sulfide in neutral or basic solution (with triethylamine added). Measurements were made extending the range over which the volumetric properties of hydrogen sulfide have been investigated to 220° C and 2000 atm. A virial expression in density was used to represent the data. Electrical measurements were made on supercritical hydrogen sulfide over the density range of 10-24 moles per liter and at temperatures from the critical temperature to 220° C. Dissert. Abstr.

N69-22125 Johns Hopkins Univ., Baltimore, Md.
CRYSTAL GROWTH AND HABIT MODIFICATION
Philip MacMannulus Howe (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-10569

A mechanism is proposed to account for the effect of impurities upon the rate of growth and the habit of crystals grown from solution. The theory predicts that, in the presence of strongly adsorbed impurities, the rate of growth of a crystal of ammonia gas in water. This was of interest because the literature values show much greater uncertainty for this process than is desirable for a substance of this importance. The observed heat of solution was $\Delta H^\circ = -8{,}529$ calories per mole. The necessary corrections combined with the observed value to give $\Delta H^\circ = -8{,}554 \pm 13$ for the standard enthalpy of solution of ammonia gas. This is in direct disagreement with the recommended "best value" of $-8{,}155 \pm 150$ calories per mole. Acceptance of our results will indicate an error in the heat of formation of ammonia gas or that of the aqueous ammonium ion or both. Dissert. Abstr.

N69-22133 State Univ. of New York at Buffalo.
AN INVESTIGATION OF THE SELF-ASSOCIATION OF POLAR MOLECULES
George Albert Chappell, III (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-11519

The self-association in carbon tetrachloride of solutes containing the carbonyl, nitrile, nitro and sulfoxide polar groups has been studied by dielectric constant measurements and by freezing point depression determinations. The dielectric constant data are discussed in terms of the Clausius Mosotti equation and in terms of the Onsager approach. The freezing point depression data are

analyzed by a least squares comparison of the data with a series of theoretical freezing point-concentration curves, each curve representing a different value of dissociation constant. These studies indicate that the carbonyl dipolar association is the weakest type of association of those studied. This effect is probably steric since the dipole is embedded in the molecule. The mechanism of association of the molecules containing nitro dipoles is apparently such that the planes of the dipole overlap. Dissert. Abstr.

N69-22138 Colorado Univ., Boulder.
EXPERIMENTAL AND THEORETICAL LIQUID-VAPOR EQUILIBRIA IN SOME BINARY SYSTEMS
Claude Kenneth Heck, Jr. (Ph.D. Thesis) 1968 268 p
Avail: Univ. Microfilms; HC $12.15/Microfilm $3.45 Order No. 68-12407

The liquid-vapor equilibria of the helium-ethane system were determined from 290° to 170°K, up to 200 atm. The data were obtained in a vapor recirculation apparatus which was constructed for this purpose. The data are presented at five temperatures both in tabular and graphical form. Plots of enhancement factors and Henry's law constants show the data to be internally consistent within about ± three percent. Data are also presented for the liquid-vapor equilibria of the helium-neon system. These data were obtained at temperatures from 26.95° to 41.90°K, and pressures up to 200 atm. With a few exceptions, these data are also shown to be consistent within ± five percent. The data are compared to some recently published data for this system. Dissert. Abstr.

N69-22142 Rutgers Univ., New Brunswick, N. J.
THE ELECTRICAL PROPERTIES OF TIN OXIDE
Albert Fredric Peterson (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms; HC $6.20/Microfilm $3.00 Order No. 68-14268

By the use of electrical resistance, Mössbauer spectroscopy, X ray diffraction, and weight loss measurements, experimental evidence linking the nonstoichiometry to oxygen vacancies is presented. The link is the variation of structure necessitated by the lack of stoichiometry. The tin-to-oxygen ratio suggests that electrically semiconducting SnO_2 exhibits n-type conduction. From weight loss data, calcining in helium at 1050°C results in a material with only 0.9937 as much oxygen as calcining the material in oxygen at the same temperature. The X ray density of this material is 6.9981 grams/cc as compared to 7.0026 grams/cc for the same material calcined in oxygen. Mössbauer spectroscopy indicates a 10.5% increase in the line width, a decrease in the percent absorption, and a greater 's' electron density for the tin ion in the helium calcinated material. The effect of doping agents on the electrical resistance is explained via thermodynamic and structural considerations as opposed to the acceptor-donor theory. It is concluded that an anion deficiency in pure SnO_2 causes a distortion in the lattice, which in turn permits electrons to occupy the normally forbidden energy bands thereby producing extrinsic semiconductivity. Dissert. Abstr.

N69-22146# California Univ., Livermore. Lawrence Radiation Lab.
THE DIRECT DETERMINATION OF FLUORIDE IN MOLYBDENUM, RHENIUM, AND TUNGSTEN
Bruce A. Raby 9 Oct. 1968 18 p refs
(UCRL-50522) Avail: CFSTI

A procedure was developed for determination of fluoride in molybdenum, rhenium, tungsten, and rhenium-tungsten alloys. The sample is fused with sodium nitrate and sodium hydroxide in a platinum crucible, and the melt is dissolved in water. A Dowex 1-X8 anion exchange column and 0.5 M sodium chloride eluriant separate the fluoride from the metal. The fluoride is determined in the eluate with a fluoride ion activity electrode. An alternate procedure, used when only molybdenum and/or tungsten are present, is to measure the pF of the melt solution without a prior separation of the metal. These procedures may be used to determine 1 to 1000 μg of fluoride in a gram sample, with a relative standard deviation of about ± 2%. Author (NSA)

N69-22164 Michigan Univ., Ann Arbor.
AN INVESTIGATION OF THE REACTION BETWEEN HYDROGEN SULFIDE AND OZONE IN A LAMINAR-FLOW REACTOR
Jeremy Morgan Hales (Ph.D. Thesis) 1968 160 p
Avail: Univ. Microfilms; HC $7.40/Microfilm $3.00 Order No. 68-13320

Experimental data were obtained from two tubular, laminar-flow reactors having diameters of 3/8 in. and 1/4 in., with respective lengths of 168.9 cm and 141.4 cm. The range of hydrogen sulfide concentrations was 13.4 to 325 micromoles/liter, range of ozone concentrations was 6.9 to 29.2 micromoles/liter, and, reactor temperatures were 28.5°C and 48°C. An expression was obtained for the rate of generation of sulfur dioxide by reaction of hydrogen sulfide with ozone in the absence of light. Comparison of data from the two reactors indicated that the reaction was almost totally homogeneous. From the results of previous authors, the expression $H_2S + O_3 \rightarrow SO_2 + H_2O$ is thought to represent the true stoichiometry adequately under the experimental conditions of the present study. The present investigation also provides an examination of the tubular, laminar-flow reactor as a means for measuring homogeneous and heterogeneous reaction rates. Dissert. Abstr.

N69-22180# California Univ., Berkeley. Lawrence Radiation Lab.
RADIO FREQUENCY STARK SPECTRA OF NaCl, NaBr, AND BaS BY THE MOLECULAR BEAM ELECTRIC RESONANCE METHOD
Carlos A. Melendres (Ph.D. Thesis) Jun. 1968 105 p refs
(Contract W-7405-eng-48)
(PB-180823; UCRL-18344) Avail: CFSTI CSCL 07D

The strong-field radio-frequency Stark spectra of Na(23)Cl(35), Na(23)Cl(37), Na(23)Br(79) and Na(23)Br(81) have been observed by the molecular beam electric resonance method of molecular spectroscopy. Analysis of spectral lines obtained by observing transitions of the type J = 1, m sub J = + or − 1 yields m sub J = 0 at strong electric fields yielded molecular dipole moments and nuclear hyperfine interaction constants for the different vibrational states of the molecules. A beam of BaS was successfully obtained. The Stark line corresponding to J = 1, m sub J = 0 yields J = 1, m sub J = + or − 1 transition was observed at moderately weak fields from which was obtained the ratio mu squared/B for the three lowest vibrational states. Author (USGRDR)

N69-22181# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
HYDROGEN SLUSH DENSITY REFERENCE SYSTEM
D. H. Weitzel, C. F. Sindt, and D. E. Daney 1968 11 p refs Submitted for publication
(PB-180889; R-467) Avail: CFSTI CSCL 07D

A hydrogen slush density reference system is described. The density of the hydrogen was calculated by a nuclear radiation attenuation densitometer up to and past its triple point. The method has been used to measure the density of liquified slush hydrogen flow loop. USGRDR

N69-22182# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THE ADSORPTION ISOTHERMS OF METHANE, NITROGEN, HYDROGEN AND THEIR MIXTURES ON CHARCOAL AT 76° K
A. J. Kidnay, M. J. Hiza, and P. F. Dickson 1968 13 p refs Submitted for publication
(PB-180887; R-465) Avail: CFSTI CSCL 07A

The pure component adsorption isotherms of nitrogen, methane, and hydrogen were measured at 76K and in the pressure ranges 0.19 to 13.5 mm Hg, 0.082 to 6.808 mm Hg, and 1.45 to 95.00 atm, respectively. Binary adsorption isotherms for mixtures of 340 ppm nitrogen, 1450 ppm nitrogen, 352 ppm methane, and 770 ppm methane in hydrogen were measured at 76K and in the pressure range of 5 to 82 atm. A ternary isotherm for a mixture of 415 ppm methane plus 686 ppm nitrogen in hydrogen was also determined in the pressure range of 6 to 48 atm.
Author (USGRDR)

N69-22183# California Univ., Berkeley. Lawrence Radiation Lab.
STRAIN-ENERGY INTERACTIONS BETWEEN SOLUTE ATOMS AND DISLOCATIONS
Tibor Stefansky (Ph.D. Thesis) Jul. 1968 72 p refs
(Contract W-7405-eng-48)
(PB-180838; UCRL-18332) Avail: CFSTI CSCL 07D

The stress required to drive a single dislocation through a fixed array of isotropic stress centers, due to substitutional solute atoms, is calculated using linear elasticity and numerical methods. Cottrell's model of the strain-energy interaction between solute atoms and dislocations is extended by allowing the dislocation to relax to its equilibrium shape in the stress fields of such atoms. Two new results are obtained. First, a marked concentration dependence of the flow stress is observed only in the very dilute range. And second, the force-displacement diagrams for cutting the stress fields of attractive and repulsive impurity atoms in solution are not identical.
USGRDR

N69-22191 Massachusetts Univ., Amherst.
LIGHT SCATTERING AS A TOOL FOR THE STUDY OF RESPONSE MECHANISMS ON DEFORMING CRYSTALLINE POLYMERS
Peter Franklin Erhardt (Ph.D. Thesis) 1968 472 p
Avail: Univ. Microfilms: HC $21.40/Microfilm $6.00 Order No. 68-13487

As indicated in the title, this thesis is in part an examination of the techniques of dynamic light scattering for the purpose of determining their applicability for the study of the deformation processes occurring in crystalline polymers. Chapters I deals with early attempts to study spherulite deformation by low angle light scattering during short time relaxation. Chapter II describes a high speed double ended stretching apparatus is described. Chapter III summarizes an extension of the Stein-Wilson treatment of random orientation fluctuation theory to the non-random case and is presented in more detail here. Chapter IV is an alternate approach to the non-random orientation correlation problem in which Fourier expansion of the correlation function is used to obtain a solution of the two dimensional unoriented case. Chapter V presents a description of an apparatus for wide angle dynamic light scattering in which the stress field can be either vibrational or provide for constant rate of extension. Chapter VI presents light scattering data on uniaxially crystallized polybutene-1.
Dissert. Abstr.

N69-22199# California Univ., Berkeley. Lawrence Radiation Lab.
SUBLIMATION KINETICS OF ZINC SINGLE CRYSTALS
Raymond Wing Mar (Ph.D. Thesis) May 1968 98 p refs
(Contract W-7405-eng-26)
(PB-180809; UCRL-18257) Avail: CFSTI CSCL 07D

The kinetics of the free surface sublimation of zinc single crystals were investigated using the torsion-Langmuir technique in conjunction with optical and electron microscopes. Sublimation from cleaved surfaces took place in two distinct stages, a stage of pressure increase with time following by a stage in which steady state pressures were measured. The first stage was correlated with the formation of thermal pits on the surface and the subsequent increase in dimensions of the pits. Thermal pits formed at places where dislocations intersected the surface, but only one out of every 10 to 20 dislocations, as measured by chemical etching formed thermal pits. The cleaved surface was found to hinder the motion of the evaporation ledges. This hinderance is probably a result of strong adsorption of contaminants on the cleaved surface.
Author (USGRDR)

N69-22209 Syracuse Univ., N.Y.
VOLUMETRIC BEHAVIOR OF ETHYL ALCOHOL AT HIGH PRESSURES AND TEMPERATURES
Hing Yang Lo (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-13845

An apparatus was constructed for the measurement of the pressure, volume, and temperature behavior of fluids at elevated temperatures and pressures, using the constant volume method. This apparatus is suitable for measurements up to 10,000 psi and temperatures to 500°C. Experimental PVT behavior data were obtained for ethyl alcohol from 200 to 350°C with pressures between 1,000 and 10,000 psi; smoothed compressibility factors for these ranges are reported. The experimental values of ethyl alcohol were found to compare favorably with previously reported experimental data at low pressures. The compressibility factor followed normal fluid behavior over the complete range of temperature and pressure, as predicted by the small value of the fourth parameter for this substance.
Dissert. Abstr.

N69-22219# Dow Chemical Co., Golden, Colo.
DESORPTION FROM PLUTONIUM DIOXIDE
Jerry L. Stakebake and Marston R. Dringman 21 Nov. 1968 9 p refs
(Contract AT(29-1)-1106)
(RFP-1248) Avail: CFSTI

The outgassing of plutonium dioxide, previously exposed to air, was investigated over the temperature range from 25° to 1000°C. This investigation broadened the perspective of the adsorption properties and gas-solid interactions of this material. Plutonium dioxide was found to exhibit a strong gettering action toward water vapor, carbon dioxide, and nitric oxide. Water vapor and carbon dioxide are adsorbed directly from the atmosphere. The nitric oxide is believed either to be adsorbed as a radiolysis product of air or to be the result of radiolytic decomposition of air in the adsorbed state. A qualitative comparison of the adsorption strengths of the major products is CO_2 > NO > H_2O. Approximately 95% of the adsorbed gases can be removed by outgassing the oxide at 700°C.
Author (NSA)

N69-22223 University of Southern Calif., Los Angeles.
THE MICROWAVE SPECTRA OF METHYLCYCLOPROPANE AND 2,2 DIFLUORO 1 METHYLCYCLOPROPANE

Robert Gale Ford (Ph.D. Thesis) 1968 64 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-10228

The microwave spectra of methylcyclopropane and 2,2 difluoro 1 methylcyclopropane, hereafter referred to as I and II, respectively, were studied in the region 8-38 gHz. The dipole moments of the compounds were measured by observing the Stark effect on the rotational transitions with the result μ_I = 0.139 debye and μ_{II} = 2.37 debye. The ground state rotational constants of I were used to fit the methyl carbon to cyclopropane ring distance and angle. The barrier to internal rotation of the methyl group was determined for each compound from splittings of the ground state rotational transitions of I and splittings of the first excited methyl torsional state transitions of II. The barriers are 2860 calories per mole and 2260 calories per mole for I and II respectively.
Dissert. Abstr.

N69-22263# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATE STANDARD ON CONCENTRATED NITRIC ACID
May 1968 10 p refs Transl. into ENGLISH from the Russian
(AD-681580; FTD-HT-23-35-68) Avail: CFSTI CSCL 7/2

This article covers the State standard on concentrated nitric acid, obtained by a method of concentrating diluted nitric acid as well as by the direct synthesis method.
TAB

N69-22269# Stanford Linear Accelerator Center, Calif.
ELECTRON INDUCED DESORPTION OF GASES FROM ALUMINUM
E. L. Garwin, E. W. Hoyt, M. Rabinowitz, and J. Jurow Jun. 1968 15 p refs Presented at the 4th Intern. Vacuum Congr., Manchester, Engl., 17-20 Apr. 1968
(PB-180743; SLAC-Pub-392) Avail: CFSTI CSCL 20G

The electronic desorption of CO and its readsorption on aluminum (natural oxide film) was studied and found to be influenced by the adsorption of H2. A theoretical model was developed which fits the experimental data and reliably predicts the adsorption-desorption characteristics at low electron energies (100 - 300 eV). At higher energies the picture is complicated by the release of subsurface gases identified as such by using CO18 techniques.
Author (USGRDR)

N69-22279# Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Aerodynamic Research Dept.
INFRARED MEASUREMENTS OF THE VIBRATIONAL EXCITATION AND DE-EXCITATION RATES OF N2 USING CO ADDITIVE
Anthony L. Russo and William S. Watt Nov. 1968 19 p refs
(Contract F44620-68-C-0011)
(AD-681508; CAL-AF-2567-A-1; AFOSR-68-2811) Avail: CFSTI CSCL 7/4

Shock wave and nozzle expansion flow studies have been made of the vibrational relaxation of N2 in a 95% N2 + 5% CO test gas mixture by observing the infrared optical activity of the CO. The large cross section for vibration-vibration exchange between N2 and CO permits the vibrational temperature of the N2 to be inferred from band reversal measurements of CO. Behind shock waves with equilibrium temperatures in the range of 1500K - 2100K the vibrational relaxation rates for N2 obtained by this method are shown to be in good agreement with previous measurements of the N2 vibrational relaxation rate. In nozzle expansion flows of the same test gas from reservoir temperatures of 2800K - 4000K and reservoir pressures of about 50 atm, the vibrational temperatures of N2 are found to be much closer to equilibrium values than predicted using the relaxation rates determined behind shock waves. These observations are in complete agreement with results obtained earlier in the N2 by line-reversal spectroscopy. Both N2 and CO have been observed to exhibit faster rates for vibrational de-excitation in nozzle flows than predicted using vibrational rate data obtained in the shock wave excitation environment.
Author (TAB)

N69-22280# California Univ., Berkeley. Lawrence Radiation Lab.
FORMATION OF DROPLETS OF ANOMALOUS WATER ON A FLAT QUARTZ SURFACE [OBRAZOVANIE KAPELEK ANOMALNOI VODY NA PLOSKOI POVERKHNOSTI KVARTSA]
B. V. Deryagin et al Aug. 1968 6 p refs Transl. into ENGLISH from Kolloidn. Zh. (Moscow), v. 30, no. 2, 1968 p 308-309
(PB-180857T; UCRL-Trans-10263) Avail: CFSTI CSCL 07D

The condensation of water vapor on a flat quartz surface was found to lead to microdrops with anomalous properties.
Author (USGRDR)

N69-22287# Institutt for Atomenergi, Kjeller (Norway).
DETERMINATION OF SOME LANTHANIDE ELEMENTS IN APATITES BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS
E. Steinnes Oct. 1967 20 p refs
(PB-180513; KR-120) Avail: CFSTI CSCL 07E

The content of lanthanum, samarium, europium, and dysprosium in six apatites of various localities was determined by neutron activation and gamma spectrometry. The gamma activity measurements were performed by means of a sodium iodide detector, and were based on the complex X ray peak at about 40 KeV for Sm, Eu, and Dy, and on the 1590 KeV photo-peak for La. The results obtained are probably accurate to plus or minus 10% or better. In some of the samples the relative abundance of europium compared to the other lanthanides appear to be significantly low.
Author (USGRDR)

N69-22308# Chicago Univ., Ill.
PARAMAGNETIC RESONANCE ABSORPTION Progress Report
Clyde A. Hutchison, Jr. Dec. 1968 9 p
(Contract AT(11-1)-294)
(COO-294-8) Avail: CFSTI

The fitting of spin hamiltonians to the Electron-Nuclear Double Resonance (ENDOR) spectra of $^{147}Sm^{3+}$ and $^{149}Sm^{3+}$ in $LaCl_3$ single crystals was completed. Single crystals of ThO_2 were doped with ^{235}U and the $^{235}U^{4+}$ nuclear hyperfine patterns arising from the f electrons of the T_{2g} state of U^{4+} at the Th^{4+} site were obtained. Studies of electron spin double resonance and of the dynamics of ENDOR in rare earth ions in single crystals were begun. The ENDOR spectra of triplet-state protobenzene in deuterobenzene single crystals is being investigated along with diphenylmethylene in diphenylethylene crystals and phenanthrene in diphenyl. Zero field line shapes are discussed.
(NSA)

N69-22328# California Univ., Livermore. Lawrence Radiation Lab.
MECHANISM OF THE THERMOLUMINESCENCE OF THE RETARDED FLUORESCENCE OF DIO-PHENANTHRENE IN VARIOUS SOLIDIFIED SOLVENTS [SUR LE MECANISME DE LA THERMOLUMINESCENCE DE LA FLUORESCENCE RETARDEE DU PHENANTHRENE d10 DANS DIFFERENTS SOLVANTS RIGIDIFIES]

A. Martiez and D. Dorignac Aug. 1968 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), (Paris), no. 266B, 1968 p 605–607
(PB-180658T; UCRL-Trans-10265) Avail: CFSTI CSCL 07D

When the transition points of saturated hydrocarbons such as n-pentane, cyclopentane, and cyclohexane are reached, the molecules of d10-phenanthrene do not appear to be liberated from their sites. With ether or alcohol solutions, an intense thermoluminescence peak of the retarded fluorescence is observed. These peaks occur at the same temperature but with different intensities, depending on the concentration of d10-phenanthrene, if the solvent is the E.P.A. (ether, n-pentane, alcohol) mixture. Author (USGRDR)

N69-22335# Los Alamos Scientific Lab., N. Mex.
OXYGEN TRANSPORT IN SODIUM
Charles C. McPheeters and John C. Biery [1968] 18 p refs Presented at the Conf. on Sodium Technol. and Large Fast Reactor Design, Argonne, Ill.
(Contract W-7405-ENG-36)
(LA-DC-9669; Conf-681106-1) Avail: CFSTI

The cold trapping experiments indicated that increased Reynolds' number had a profound effect on the rate of removal of oxygen from the system. This velocity effect indicates that the rates are diffusion limited. Increased Reynolds' number caused an increase in the mass transfer coefficient proportional to the first power of the Reynolds' number. Cold trap temperature and absolute concentration had little effect on the mass transfer coefficient as shown by the observation that the dissolution and precipitation rate constants were nearly equal in coupled constant velocity runs. However, the rate coefficients were found to be a function of the initial concentration driving force. The implication is that the character of the precipitate and its specific area were modified by the driving force available for nucleation of the initial crystals. Breakaway of oxide deposits in the cold trap was observed. This phenomenon points out an important function of packing materials–that of holding the oxide deposits in position and preventing recontamination of the system by oxide breakaway. Author (NSA)

N69-22339# Michigan State Univ., East Lansing. Dept. of Chemistry.
THE VIBRATIONAL SPECTRA OF DICYANODIAZOMETHANE (CCN)2CNN) AND THE DICYANOMETHYLENE FREE RADICAL (C(CN)2)
William Hayden Smith and George E. Leroi Feb. 1969 29 p refs
(Contract N00014-68-A-0109)
(AD-682230; TR-6(11)) Avail: CFSTI CSCL 7/4

Infrared spectra were obtained for (CN)2CNN in the solid state and isolated in inert matrices. Crude Raman spectra of dicyanodiazomethane in acetonitrile solution were also obtained. The vibrational analysis has been performed on the basis of C2v symmetry and correlated with the spectra of a number of related molecules. Photolysis of matrix isolated (CN)2CNN yields sufficient :C(CN)2 (dicyanomethylene), stabilized in situ, to permit observation of the infrared spectrum. The results of the vibrational analysis indicate that the linear diradical has an extremely low central carbon bending frequency, analogous to those of C3O2 and C3S2. Author (TAB)

N69-22347# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astro Physics Lab.
LABORATORY MEASUREMENTS OF PHOTOIONIZATION, PHOTOEXCITATION AND PHOTODETACHMENT
Richard I. Schoen Oct. 1968 83 p refs Presented at the Symp. on Lab. Meas. of Aeronomic Interest, Toronto, 3–4 Sep. 1968
(AD-682082; D1-82-0768) Avail: CFSTI CSCL 7/5

This review is devoted to a discussion of laboratory measurements of ionization, fluorescence, and photodetachment. The review is limited to molecules of aeronomic interest but excludes atoms. The section on photodetachment includes only work which has appeared since 1964. Current data are presented on photoionization cross sections, dissociative ionization cross sections, cross sections for the excitation of particular states of ions, relative vibrational excitation probabilities, photodetachment cross sections, angular distributions of electrons from photoionization and dissociative excitation of neutral molecules. Some suggestions are made for further work. Author (TAB)

N69-22351 Toulouse Univ. (France). Inst. du Génie Chimique.
SULFUR OXIDES IN MODERN CHEMISTRY [LES OXYDES DU SOUFRE DANS LA CHIMIE MODERNE]
Edouard Privat 1968 221 p refs Partly in ENGLISH; partly in FRENCH; partly in GERMAN Proc. of the Intern. Congr. on Sulfur, Toulouse, 22–26 May 1967 *Its* Ann. du Génie Chim., Vol. 3
Copyright: Avail: Edouard Privat, Toulouse

Conference papers on sulfur oxides in modern chemistry are presented. For individual titles see N69-22352 through N69-22383. (ESRO)

N69-22352 Toulouse Univ. (France). Inst. du Génie Chimique.
PRODUCTION OF SULFUR DIOXIDE BY COMBUSTION OF SULFUR [PRODUCTION DE DIOXYDE DE SOUFRE PAR COMBUSTION DU SOUFRE]
J. Cathala *In its* Sulfur Oxides in Mod. Chem. 1968 p 23–30 In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The thermal balance for the combustion of sulfur in an adiabatic reactor, fed continuously with liquid sulfur at 120°C is considered. A stream of dry air enters the reactor at 25°C and its oxygen is totally converted into sulfurous gas. In the stationary state, for each mole of SO_2 formed, 3.762 moles of nitrogen and X atoms of sulfur as saturated vapor leave the reactor. Systematic calculations for a temperature range between 340 and 540°C show that the amount of evaporation which accompanies adiabatic combustion of sulfur is extremely significant. For a sulfur part burnt at 372°C in air at atmospheric pressure, 14.4 parts evaporate. Various evaporating burners have been fabricated either for the production of sulfur dioxide in industrial plants with an output of 18 to 20 tonnes per day or for the production of sulfur vapor intended for a variety of applications. Author (ESRO)

N69-22353 Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
THERMODYNAMICS OF DISULFUR MONOXIDE. STABILITY COMPARISON BETWEEN DISULFUR MONOXIDE AND SULFUR MONOXIDE [ETUDE THERMODYNAMIQUE DE S_2O. COMPARAISON DES CONDITIONS DE STABILITE DE S_2O ET SO]
Robert Hagemann, René Botter, Guy Nief, and Etienne Roth *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 33–41 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary.
Copyright. Avail: Edouard Privat, Toulouse

The reaction of oxygen with sulfur at low pressure in a high-frequency discharge is studied. The reaction products are analyzed continuously by mass spectrometry. The only sub-oxide formed is S_2O. With this same analytical technique, the formation of S_2O from sulfur and SO_2 on hot filaments is studied at

equilibrium. The measurements, between 1,100°K and 1,500°K, of the equilibrium constant for the reaction, $SO_2 + 3/2S_2 \rightleftharpoons 2S_2O$ permit the calculation of the enthalpy of this reaction by applying either Van't Hoff's law or the third law of thermodynamics, having calculated the partition function for S_2O. The heat of formation of S_2O from S_b and O_2 is found to be $\Delta H_{f298°K}(S_2O)g = -10 \pm 0.3$ Kcal/mole. A comparison of the conditions of stability for S_2O and SO is also presented. Author (ESRO)

N69-22354 Applied Chemical Corp., Morristown, N. J.
THE STABILIZATION OF SULFUR TRIOXIDE
Everett E. Gilbert *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 42–46 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The development of sulfur trioxide stabilization and the requirements of a satisfactory stabilizer are discussed, and test procedures are outlined. Several effective compounds are shown to react easily with sulfur trioxide forming a number of products. It is therefore difficult to pinpoint the 'actual' stabilizer. The role of pressure treatment is shown to vary greatly with the particular stabilizer used. Although many compounds are good stabilizers for dry sulfur trioxide, very few are effective in the presence of added moisture. Compounds of boron are outstanding in this respect. Requirement for a liquid stabilizer led to the development of a synergistic mixture of dimethyl sulfate and boric oxide. Boron-containing stabilizers are not suitable for sulfur trioxide to be used with halogenated solvents. The theory of stabilization is discussed briefly. Author (ESRO)

N69-22355 Montpellier Univ. (France). Faculté des Sciences.
SOLID-STATE SULFONITRIC COMPOUNDS AND ISOTHERMAL LIQUID-SOLID EQUILIBRIUM [COMPOSES SULFONITRIQUES DANS L'ETAT SOLIDE ET EQUILIBRES ISOTHERMES LIQUIDE-SOLIDE]
P. Vitse, A. Potier, J. Potier, and M. Fournier *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 47–51 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The liquid-solid equilibria in the ternary system $SO_2 - N_2O_5 - H_2O$ are studied at 0°, 25°, and 50°C by the method of 'wet residues' near the pseudobinary system $1N_2O_5$, $1H_2O$. An I.R. spectrophotometric study and the discussion of the results combined with the discussion of the literature, especially in the case of oxygenated sulfur ions are presented giving some detailed structures. Author (ESRO)

N69-22356 Academy of Sciences (USSR), Moscow. Scientific Research Inst. of Fertilizers.
CONDENSATION OF SULFURIC ACID
A. G. Amelin *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 52–61 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The process of sulfuric acid condensation is complicated by several concurrent processes which are specific for the production of sulfuric acid. Therefore proper corrections should be introduced into average calculation formulae. Moreover, sulfuric acid vapor is easily condensed in volume forming a stable mist which causes great difficulties in production processes. When a vapor-gas mixture contacts a colder surface, two independent processes occur simultaneously: cooling of the gas and condensation of the vapor. The rates of these processes are in such a relation that at the beginning vapor oversaturation S increases, reaches the maximum value and then goes down. When oversaturation reaches the critical values Scr, the vapor condenses in volume forming nuclei which later increase because of condensation growth. While considering the process of vapor condensation on the surface it is necessary to differentiate strictly between conditions before and after mist formation, i.e. when S > Scr and S < Scr. In the first case the process of condensation can be calculated according to well-known formulae, in the second case a stage-by-stage method of calculation is used. The results of investigations show that at present there are available the necessary data for establishing such condensations under which the formation of mist can be eliminated. However, this is usually connected with the decrease of condensation process rate. Therefore it often appears very profitable to conduct the process at high rates with the formation of larger drops of mist and then to remove that mist in filters. Minimum material expenses for the realization of the process are determined on the one hand by vapor condensation on the surface and on the other hand, by the conditions of mist evolution in filters. Author (ESRO)

N69-22357 Toulouse Univ. (France). Faculté des Sciences.
ON SOME PROPERTIES OF SULFUR OXIDES [SUR QUELQUES PROPRIETES DES OXYDES DU SOUFRE]
Daniel Voigt, Pierrette Dagnac, and Louis Fournes *In its* Sulfur Oxides in Mod. Chem. 1968 p 62–69 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

1. The magneto-optical study of liquid sulfur trioxide shows that the rotation of the compound increases with temperature. Supposing that the sulfur trioxide is essentially composed of monomeric and cyclic trimeric molecules, an estimation is proposed of their proportion in products of different origins, at different temperatures and in the presence or absence have an experimental magneto-optical rotation smaller by 1.73 r than the calculated sum of the rotations of the composing molecules. With regard to the molecules $R_2NCHO.SO_3$(RKW(R=CH_3, C_2H_5) the difference between the calculated and the measured roration is 45μr. Although the contribution of the bond so formed is still negative, it is not identical with the preceding one. 3. The measurements carried out on powdered S_2O_3 show a small paramagnetism all the more important as the alternation of the sample is well visible. However, by preparing S_2O_3 inside a measuring tube in order to postpone that alteration or by performing the measures in oleum solution, a clear diamagnetism is observed. The measurements turned out to be very difficult and therefore only one approximative value of $M(S_2O_3)$, that is $-23.5 \cdot 10^{-6}$ CGS is given. Author (ESRO)

N69-22358 Toulouse Univ. (France). Inst. du Génie Chimique.
SULFUR DIOXIDE AND SULFUR TRIOXIDE LIQUID-VAPOR EQUILIBRIUM [L'EQUILIBRE LIQUIDE-VAPEUR SO_2/SO_3]
Y. de Mauduit *In its* Sulfur Oxides in Mod. Chem. 1968 p 70–72 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The liquid-vapor equilibrium of the SO_2/SO_3 binary mixture is studied by dynamic ebulliometry working with pressures between 650 and 950 mm of mercury and with extremely hygroscopic products; operation of the ebulliometer at low temperatures had to be ensured and it was necessary to redesign the feed and phase reception devices. Two complete graphs of equilibrium are obtained which reveal an unusual feature for the composition of 66.6% SO_3 and show that the compound defined as $SO_2.2SO_3$ is present in the dissociated state in the liquid and vapor phases. Comparison of the two isobars shows that the stability of $SO_2.2SO_3$ is dependent on temperature and pressure. Certain studies led to the conclusion: that this association is highly unstable; that its formation from its constituents appears to be irreversible; that, under conditions necessary for stability, it is present in the solid state. Accordingly there is nothing surprising about the fact that attention has so often been drawn to the existence of $SO_2.2SO_3$. Author (ESRO)

N69-22359# Toulouse Univ. (France). Inst. du Génie Chimique.
SOLUBILITY OF SULFUR DIOXIDE IN CHLORINATED SOLVENTS [SOLUBILITE DE L'ANHYDRIDE SULFUREUX DANS LES SOLVANTS CHLORES]
M. Aubry, B. Gilot, and C. Jayles *In its* Sulfur Oxides in Mod. Chem. 1968 p 73–75 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The authors studied the solubility of sulfurous anhydride in a few chlorinated solvents. The results which were obtained relate to: sulfuryl chloride; set of isothermes given by the vapor tensions; thionyl chloride; methylene chloride; dichloro-1-2-ethane; and isobar curve under 760 mm Hg. Author (ESRO)

N69-22360 Indian Inst. of Science, Bangalore.
DISULFUR MONOXIDE AND ITS CHEMICAL BEHAVIOR
A. R. Vasudeva Murthy *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 79–81 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

Pure solutions of sulfur hemioxide (SO_2O), free from sulfur dioxide, are obtained, and chemical properties of S_2O are studied. The sulfur hemioxide was prepared by heating a metallic oxide (or nitrate) in a vacuum in the presence of excess sulfur; copper, nickel and uranium were the metals used. As a function of the experimental conditions, several different hydrolysis reactions occur with the sulfur hemioxide in solution in carbon tetrachloride. S_2O may be considered as the genuine anhydride of thio-sulfurous acid. Study of oxidation of the S_2O derivatives has led to the attribution to sulfur of the +1 degree of oxidation in this compound. Author (ESRO)

N69-22361#
THE REPRESENTATION OF CHEMICAL BONDS IN BRANCHED MOLECULAR SULFUR CHAINS [DIE DARSTELLUNG VON VERBINDUNGEN MIT VERZWEIGTEN SCHWEFELKETTEN]
P. W. Schenk, R. Steudel, R. Ludwig, and J. Bilal *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 82–86 refs In GERMAN; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

Whereas pure sulfur chains are always non-branched, compounds are mentioned here which contain the structural element S_3O, the sulfur chain consisting of from 3 to *n* atoms. In the radical polymerization of disulfur monoxide solid yellow polysulfur oxides of the composition S:O > 2:1 are formed. This polymerization occurs if gaseous S_2O is condensed, introduced into solvents or if its partial pressure is increased to >1 mm Hg. By condensation of 2-thionaphthol with thionyl chloride, bis-2-naphthyl-trisulphane-2-oxide, a yellow, crystalline powder is obtained. As expected, polymeric sulfane oxides are formed by the condensation of hydrogen sulfide with thionyl chloride, and can be isolated in the course of the Wackenroder reaction, i.e. by the reaction of SO_2 with H_2S. The formation of sulfane oxides is quite independent of whether the work is done in water, in organic solvents or quite without solvent. Through the recording of low-temperature spectra and isolation of thiosulfurous acid as an intermediate it is possible to show that the reaction takes place in accordance with the following scheme: $H_2S + SO_2 \rightarrow H_2S\text{-}SO_2$ analyses, behavior on heating (disproportionation) and on reduction, above all by IR-spectra. Only one strong absorption is found (1,120 cm1) which can be interpreted only as the (S = O)stretching vibration of a thionyl group bonded to two sulfur atoms. Author (ESRO)

N69-22362 Bonn Univ. (West Germany).
ISOTOPE EXCHANGE OF SULFUR IN (SO_2/SO_3 + nH_2O) SYSTEMS [ISOTOPENAUSTAUSCH DES SCHWEFELS IN (SO_2/SO_3 + NH O_2)-SYSTEMEN]
W. Borger and L. von Erichsen *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 87–92 refs In GERMAN; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The exchange of sulfur between SO_2 and SO_3 and H_2SO_4, respectively, has been studied using S-35 as a tracer in a sealed quartz vessel over a temperature range between 250 and 500°C. A reaction rate law is derived based on the experimental data of the SO_2/SO_3 exchange as a function of the temperature. The exchange rate was not influenced by either the specific activity or small amounts of water. The reaction is of first order with respect to SO_2 and of second order with respect to SO_3. A by-product of the investigation was a new determination of the half-life of S-35 giving a value of 87.50±0.16 days. Kinetics and mechanisms of the exchange reaction are discussed in full detail. Author (ESRO)

N69-22363 Madrid Univ. (Spain).
OXIDATION OF SO_2 AND $SO_3(NH_4)_2$ IN THE PRESENCE OF LIQUID ORGANIC BASES [OXYDATION DU SO_2 ET SO_3 $(NH_4)_2$ EN PRESENCE DE BASES ORGANIQUES LIQUIDES]
A. Vian and V. M. Municio *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 93–97 refs In FRENCH; ENGLISH summary Prepared jointly with AUXINI (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

A study has been made of the oxidation of the absorbed SO_2 in organic bases of the functional amine and pyridine group. The conclusion was reached that the SO_2 represents a higher oxidation effect if it is absorbed in the system pyridine base-water, than if it is absorbed in amine base systems. Moreover, the oxidation of the SO_2 can be increased through the presence of alkyl substituents in the pyridine ring. In the attempt to study the mechanism of the SO_2 oxidation in the presence of pyridine bases, the oxidation was accomplished by the oxygen of the aqueous ammonium sulfite solutions in the presence of pyridine bases in dispersed heterogeneous phase. In this way rates of oxidation were achieved on a laboratory scale which should be of industrial interest. Author (ESRO)

N69-22364 Madrid Univ. (Spain).
OXIDATION OF SULFUR DIOXIDE ADSORBED IN PYRIDINIC RESINS [OXYDATION DU SO_2 ADSORBE SUR DES RESINES PYRIDINIQUES]
A. Vian and A. Soler-Andres *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 98–101 refs In FRENCH; ENGLISH summary Prepared jointly with AUXINI (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

In a continuation of previous work showing the activity of alkylpyridines as promoters of the oxidation of SO_2 adsorbed in pyridine, the possibility of utilizing solid copolymers derived from pearl polymerization of vinylpyridines with low proportions of divinylbenzene has been studied. The oxidation with oxygen of SO_2 adsorbed on the polymer has been investigated to determine the influence of the different factors which can affect the kinetics of the reaction: temperature, relation adsorbate-adsorbent, concentration of the oxidizing gases, varying from pure oxygen to air, water content of the polymer etc.... Author (ESRO)

N69-22365 Nicolaus Copernicus Univ., Torun (Poland). Inst. de Chimie Minérale.
SULFUR OXIDES AS PRODUCTS OF CATALYTIC OXIDATION OF HYDROGEN SULFIDE [LES OXYDES DU SOUFRE COMME PRODUITS DE L'OXYDATION CATALYTIQUE DE L'HYDROGENE SULFURE]

A. Swinarski, J. Siedlewski, and M. Rozwadowski *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 102–108 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary
Copyright. Avail: Edouard Privat, Toulouse

Catalytic oxidation of hydrogen sulfide on activated carbon is frequently applied in purification of gases and waters polluted with H_2S. Depending on the conditions of the catalysis and the composition of the gases before oxidation, the hydrogen sulfide may be oxidized either to the state of sulfur or to the state of compounds corresponding to various degrees of oxidation of sulfur. It is possible to obtain an oxidation product containing over 50 % of sulfur in oxide form. These variations in the catalytic properties of carbon depend on the composition of the gases before oxidation. A mixture rich in oxygen tends to give an increasing amount of oxides in the reaction products. They also depend on the presence of active centers on the surface of the carbon. It has been possible to distinguish centers formed by C_xO_y complexes (surface oxides). The presence of surface oxides tends to increase the proportion of sulfur oxidized to the state of sulfurous acid in the products of catalytic oxidation of hydrogen sulfide. Free radicals of variable concentration, measured by the R.P.E. signal have been formed on the surface of the carbon. The radicals tend to oxidize the sulfurous acid to sulfuric acid. Finally, supplementary activation of activated carbon by various cations seems to favor catalytic oxidation of the SO_2 without reaching the oxidation degree $SE6+$.
Author (ESRO)

N69-22366 Société Nationale des Pétroles d'Aquitaine, Lacq (France).
EXTRACTION OF SULFUR FROM GASES CONTAINING HYDROGEN SULFIDE BY REACTION ON AQUEOUS SULFUR MONOXIDE [EXTRACTION DU SOUFRE D'UN GAZ CONTENANT DE L'HYDROGENE SULFURE PAR REACTION AVEC L'ANHYDRIDE SULFUREUX EN MILIEU AQUEUX]
P. Mathieu *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 107–115 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary
Copyright. Avail: Edouard Privat, Toulouse

The reaction between H_2S and SO_2 in aqueous media has been studied with the object of obtaining elemental sulfur with good sedimentation characteristics, and of limiting the secondary reactions. An optimum temperature has also been discovered, and it has been found that sea water is a convenient reaction medium. However, if the water is recycled, the accumulation of polythionic acids has a deleterious effect on the sedimentation of the sulfur. Neutralization of the solution is therefore desirable. The technological study of the gas/liquid contact has not been started.
Author (ESRO)

N69-22367 Indian Inst. of Science, Bangalore.
OXIDATION OF SULFUR AND ITS COMPOUNDS IN HOMOGENEOUS AQUEOUS MEDIA
A. R. Vasudeva Murthy *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 116–118 (See N69-22351 11-06) refs
Copyright. Avail: Edouard Privat, Toulouse

Whereas sulfur dissolved in an organic solvent does not react in the presence of nucleophile reagents, it becomes very active when the heterogeneous phase is homogenized by addition of an appropriate solvent. The author makes use of this property in order to study the oxidation by chloramine-T of sulfur in solution in alcohol or dioxane, as well as oxidation of certain derivatives such as the 'imides', 'nitrogen tetrasulfide' (S_4N_4), the 'polythiopiperidines', the 'polythionates', sulfur chloride and sulfur bromide (S_2Cl_2 and S_2Br_2) and the derivatives of thiosulfurous acid. In his interpretation of the results the author considers that the sulfur (S_8) rings are opened and the sulfur-sulfur, sulfur-carbon or sulfur-phosphorus bonds broken, followed by oxidation of sulfur to sulfuric acid.
Author (ESRO)

N69-22368 Istituto Tecnico Industriale Stanislao Cannizzaro, Milan (Italy).
RATE AND MECHANISM OF DITHIONITE FORMATION IN AQUEOUS SOLUTION BY THE AMALGAM METHOD
Ignazio Renato Bellobono *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 119–125 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The formation of dithionite in aqueous solution by the amalgam method was investigated in the temperature range 5 to 25°C. Reaction was carried on both by sodium amalgam in a laboratory reactor operating in steady state conditions, with falling amalgam drops, and by zinc amalgam in a discontinuous, stirred reactor. In the sodium amalgam experiments, the mass-transfer treatment was applied. From the measured rates of formation of sodium dithionite, the maximum allowable sodium consumption rates were evaluated and compared with theory. Their dependence on temperature followed substantially the corresponding variation of diffusion coefficients, confirming a diffusion controlled reaction at the interface between amalgam and solution. In the zinc amalgam experiments, the rate of dithionite formation was also measured by the linear increase in the concentration of hydroxide ions. ^{35}S labelled $Z^*_nS_2O_4$ was prepared by this method and converted into $Na^*_2S_2O_4$ and $NaH^*SO_2 \cdot CH_2O$. The decomposition of labelled $Na^*_2S_2O_4$ in acid solutions was kinetically studied at 20°C, by simultaneous determination of S_2O^{2-}, SO^{2-}, S_2O^{2-}, SO_2, and S formed. Experimental evidence was found for three reactions. Dithionite formation was discussed on the basis of three suggested mechanisms in which HSO_3^+ ions play an important role.
Author (ESRO)

N69-22369 Czechoslovak Academy of Sciences, Prague. Inst. for Inorganic Chemistry.
OXIDATION OF SULFITE IONS WITH SINGLE ELECTRON OXIDIZERS [DIE OXYDATION DES SULFITIONS MIT EINAEQUIVALENT OXYDATIONSMITTELN]
J. Veprek-Siska *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 126–131 refs In GERMAN; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The catalytic effect of cupric ions on the reaction of sulfite with oxygen is explained by the one-electron oxidation of sulfite and the reactions of the SO3 radicals thus formed. In the effort to obtain new experimental data on the individual reactions of the catalytic oxidation of sulfite the author has studied the reactions of sulfite with various one-electron oxidizers. It has been found that monovalent oxidizing agents oxidize sulfite in two different ways. Those that have the character of substitution labile complexes oxidize sulfite with the formation of sulfate and dithionate. Substitution inert complex ions oxidize sulfite to sulfate only. A study of the kinetics of the reaction of sulfite with the complex ion $[Fe(CN)_6]3-$, which is substitution inert, has proved that the reaction follows a kinetic equation of the second order. From the results obtained it follows that the rate-controlling process of the reaction is the substitution of the sulfite ion into the oxidizing complex. The free radical SOSO3 does not seem to be an intermediate of one-equivalent oxidation of sulfite with hexacyanoferrate.
Author (ESRO)

N69-22370 Tohoku Univ., Sendai (Japan). Chemical Research Inst. of Non-Aqueous Solutions.
INFRARED AND RAMAN SPECTRA OF ALIPHATIC ALCOHOLS, BENZENE, AND AMINES IN SULFUR DIOXIDE AS A SOLVENT
Susumu Kinumaki and Tetsuo Hata *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 135–139 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

Infrared spectra of methanol, ethanol, n- and iso-propanol, and n-, iso-, sec- and t-butanol in liquid sulfur dioxide have been measured. From the frequency shift and band intensity the OH monomer band is considered to be due to the formation of alkylsulfurous acid, RO- SO-OH. The spectra of benzene, dimethylamine, trimethylamine, triethylamine, N, N-dimethyl-and N, N-diethyl-aniline in solvent sulfur dioxide are explained by the formation of respective benzene-, amine-SO_2 complexes, but both methylamine and ethylamine react rapidly with sulfur dioxide, and produce Ch_3NsO and C_2H_5NsO respectively in addition to $(RnH_3)_2S_2O_5$. Author (ESRO)

N69-22371 Osaka Univ. (Japan). Dept. of Applied Chemistry.
RADICAL REACTION OF ANTHRACENE WITH SULFUR DIOXIDE
Niichiro Tokura, Toshikazu Nagai, and Hiroshi Takeuchi *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 140–145 refs (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The reaction of anthracene with sulfur dioxide in the presence of light or a radical initiator is examined and discussed. Irradiations of anthracene with sulfur dioxide in various solvents are classified into two categories. In n-hexane or carbon tetrachloride anthracene gives anthracene-9 sulfonic acid and 9,9'-dianthranyl sulfonic acid. In benzene or carbon disulfide, the dimer and endoperoxide of anthracene are produced indicating the interaction of benzene with sulfur dioxide. The solvent effects of the reaction of anthracene with sulfur dioxide in the presence of radical initiators such as benzoyl peroxide and azobisisobutyronitrile are also studied. The reaction systems in benzene also exhibit the presence of a special interaction of SO_2 with benzene. Author (ESRO)

N69-22372 Hungarian Academy of Sciences, Budapest. Technical Center for Hungarian Chemical Industry.
SULFONATION OF ALKYL-BENZENE COMPOUNDS AND OF FATTY ALCOHOLS BY SULFUR TRIOXIDE IN THIN LAYER REACTORS [SULFONATION DES ALCOYL-BENZENES ET DES ALCOOLS GRAS PAR L'ANHYDRIDE SULFURIQUE GAZEUX DANS DES REACTEURS A COUCHE MINCE]
Georges Honti *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 146–150 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

The author has developed a special thin layer reactor. After the completion of laboratory experiments, first series of pilot plant tests were conducted in order to study the sulfonation of dodecyl-benzene, with counter-current circulation of a gas containing $7.62 \pm 0.75\%$ SO_3 (cooled on leaving the converter), and an output was obtained of 85 to 98% with a molar ratio for SO_3/DDB between 1.4 and 1.5. The effects of temperature of the molar ratio and of the rate of rotation of the agitator were examined. The optimum corresponds to a rate of 440 r.p.m. and a temperature of 50 to 60°C. The quality of the product obtained in this way conformed with the normal standards and specifications. Author (ESRO)

N69-22373 Toulouse Univ. (France). Inst. du Génie Chimique.
CHEMICAL REACTIONS IN LIQUID SULFUR DIOXIDE [REACTIONS DANS LE DIOXIDE DE SOUFRE LIQUIDE]
G. H. Weinreich, M. Jufresa, and M. L. Salvat *In its* Sulfur Oxides in Mod. Chem. 1968 p 151–156 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

Liquid sulfur dioxide is an excellent solvent for the realization of a number of reactions which would not take place or would follow another mechanism in another solvent. Particularly as solvent for sulfur trioxide it allows the synthesis of the whole series of mixed anhydrides of sulfur and nitrogen oxides, chloropoly-sulfonic acids of exactly determinated molecular weight and amino-sulfonic acids. In organic chemistry the objects of the authors' investigation were the reactions of SO_3 dissolved in liquid SO_2 with acetylenic and ethylenic hydrocarbons, alcohols, diols and ethers. The reactions with olefins follow an identical mechanism to that given by reactions with the Dioxan/SO_3 complex, but yields are better and endproducts purer; alcohols form acid sulfates and then neutral sulfates. By analogy, diols give first sulfated derivatives which more or less easily cyclize depending on their structure. Finally in the case of ethers the intermediate formation of a complex which goes over to neutral sulfate with a kinetic of the first order is shown. Author (ESRO)

N69-22374 Monsanto Chemical Co., St. Louis, Mo.
PILOT PROCEDURE FOR CONVERTING THE SULFUR OXIDES IN FLUE GASES INTO SULFURIC ACID [NOUVEAU PROCEDE VALORISANT SOUS FORME D'ACIDE SULFURIQUE LES OXYDES DE SOUFRE CONTENUS DANS LES FUMEES]
J. A. Rauscher, H. Acton (Simon-Carves Ltd., Stockport, Engl.) and R. F. Barut (S. A. Heurtey, Paris) *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 159–161 In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

This new process consists essentially in removing the fly ash content of the flue gas from the boiler. Next, about 90% of the SO_2 is oxidized to SO_3 by passage through beds of vanadium catalyst. The flue gases are then cooled by heat exchange with combustion air. This cooling causes weak sulfuric acid mist to form. The acid mist is collected by a high efficiency Brink-mist eliminator. The acid may be sold as produced or concentrated depending on the acid strength collected and the requirements of the market. Gases exhausted to the atmosphere contain 0.01 to 0.03 0.03% SO_2 giving efficiencies of 70 to 90%. It is investigated that a 500,000 kW power plant will produce 500 tons per day of 100% sulfuric acid at a concentration of 78 %. Investments for such a unit will be 15 to 30% to the cost of the power plant. Author (ESRO)

N69-22375 Société Nationale des Pétroles d'Aquitaine, Lacq (France).
STUDY OF CATALYSTS FOR THE SNPA SULFURIC ACID PLANT AT LACQ [ETUDE DE CATALYSEURS POUR L'UNITE D'ACIDE SULFURIQUE DE LA SNPA A LACQ]
G. Desgrandchamps *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 162–174 refs In FRENCH; ENGLISH summary (See N69-22351 11-06)
Copyright. Avail: Edouard Privat, Toulouse

This study was conducted to compare the activities of three commercial catalysts for the conversion of SO_2 to SO_3 in the particular conditions of the Lacq plant: very small SO_2 concentrations; wet catalysis; presence of H_2 and CO. It was worked on a gas composition very close to that of an integral isothermal reactor: SO_2 = 1 %; H_2 = 1 %; CO = 0.5 %; O_2 = 4.5 %; was not changing unfavorably the thermodynamic equilibrium SO_2-SO_3, neither by oxygen consumption (it is present in a sufficient large excess) nor by a temperature rise in the adiabatic converter resulting from their oxidation heat. Then the kinetics of SO_2 conversion in an integral isothermal reactor was studied. In the absence of H_2 and CO the kinetic treatment is

the results gave the coefficients of equations fitting well with the isothermal behavior of those catalysts. In the presence of H_2 and CO the preceding results were not altered over two of the three catalysts on study. In these cases it seems that the three oxidations occurred in parallel, without reciprocal inhibition nor competition for the catalyst. Author (ESRO)

N69-22376 Czechoslovak Academy of Sciences, Prague. Usti (Czechoslovakia). Research Inst. for Inorganic Chemistry.

A CZECHOSLOVAKIAN PROPOSAL OF AMMONIACAL FLUE GAS DESULFURIZING FOR A 100 MW POWER PLANT

R. Klimecek *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 175–179 (See N69-22351 11-06)

Copyright. Avail: Edouard Privat, Toulouse

The author studies desulfuration of the smoke produced by lignite burning steam generating stations. This study is based on a modification of the 'ammonia method' known under the designation 'cyclic method'. After prior cooling to 35°C and dust extraction, the smoke is washed in two stages by an aqueous ammonium sulfite-bisulfite solution and is then returned to the atmosphere with residual SO_2 and ammonium content of less than 0.01 % by volume. The SO_2 enriched washing liquid undergoes thermal regeneration by steam. After elimination of part of the SO_2 by desorption and elimination of the $(NH_4)_2SO_4$ by crystallization at 35° the liquid is recycled. The SO_2 which is freed during thermal regeneration is cooled, dried and liquefied by compression. The project is designed for an industrial unit with a power of 100 MW. The desulfuration unit is based on results obtained on the pilot scale. This project was drawn up to take into account criticism levelled at the conventional 'wet' methods. The process makes use of the results obtained during fundamental research conducted over a period of about ten years which led to the construction of a new and entirely satisfactory absorption column. Tests of the process and equipment on a 5 MW technical scale are currently in progress; the aim of these tests is to examine dust extraction flue gas cooling and re-heating and automatic regulation of the installation. Author (ESRO)

N69-22377 Imperial Coll. of Science and Technology, London (England).

THE COMBUSTION OF SULFUR DIOXIDE TO SULFUR TRIOXIDE IN THE PRESENCE OF ORGANIC FUELS

C. F. Cullis and L. Trimm *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 180–183 refs (See N69-22351 11-06)

Copyright. Avail: Edouard Privat, Toulouse

Studies have been made of the extent to which sulfur dioxide is oxidized to sulfur trioxide in the presence and absence of various fuels. In general, it is found that the conversion is very low when the fuels are saturated and unsaturated hydrocarbons and oxygenated organic compounds, except under conditions where explosion occurs. In the presence of certain nitrogen compounds, however, the amounts of sulfur trioxide formed under non-explosive conditions are considerably higher. This can almost certainly be ascribed to the powerful catalytic effect of nitrogen oxides on the oxidation of sulfur dioxide, since there is some correlation between the extent of formation of such compounds and the quantities of sulfur trioxide produced. The amounts of nitrogen oxides formed appear to be dependent on the structure of the nitrogen compounds undergoing oxidation. Author (ESRO)

N69-22378 Japan Catalytic Chemical Industry Co. Ltd., Osaka.

RESEARCHES ON CONTACT REACTION RATE FOR SULFUR DIOXIDE OXIDATION

Haruichi Hara *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 187–196 refs (See N69-22351 11-06)

Copyright. Avail: Edouard Privat, Toulouse

The velocities of the subject title over V_2O_5-industrial catalyst were measured for both forward and reverse reactions using a differential reactor. For gas phase reactions represented generally as $aA + bB = gG$, an approximate rate formula of catalytic reaction was derived theoretically in case of the reactions being in stationary state and having no side and no consecutive reactions. Results of applying the derived formula to the experimental data and to many reactor designs for sulfuric acid factories in Japan were satisfactory. Author (ESRO)

N69-22379# Academy of Sciences (USSR), Leningrad. Lensoviet Inst. of Technology.

AN OXIDATION OF SULFUR DIOXIDE IN A CATALYST SUSPENDED BED

I. P. Muchlenov and E. S. Rumyantzova *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 197–201 (See N69-22351 11-06)

Copyright. Avail: Edouard Privat, Toulouse

Investigations of the contact oxidation of sulfur dioxide in a suspended bed of a catalyst, carried out on laboratory, pilot-plant and production-plant scales, made it possible to define the required technological characteristics of this process. The influence of temperature, concentration of reacting substances, linear gas velocity and other factors, on the development of catalytic processes in a fluidized bed, have been studied. In a single bed of catalyst, oxidation of concentrated sulfurous gases is incomplete, only 60 to 80% conversion being achieved. In an apparatus of 4 or 5 catalyst beds, conversion is 98% complete. Several equations characterizing the kinetics of sulfur dioxide oxidation processes in a suspended bed of a catalyst are presented. Highly resistant catalysts, based on oxides of vanadium and of iron have been manufactured and studied. They are equally as active as catalysts at present in use. Author (ESRO)

N69-22380# Adam Mickiewicz Univ., Poznan (Poland). Inst. de Technologie Chimique.

INVESTIGATION OF CR_2O_3 BASED CATALYSTS FOR PRODUCTION OF SULFUR TRIOXIDE [ESSAIS DE CATALYSEUR A BASE DE CR_2O_3 POUR LA PRODUCTION DU SO_3]

W. Kuczynski *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 202–205 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary

Copyright. Avail: Edouard Privat, Toulouse

Based on previous investigations dealing with the modification of vanadium catalyst, Al_2O_3 has been used as the support of a chromic catalyst designed for the catalytic oxidation of SO_2. The catalysts were prepared by coprecipitation from mixed solutions of chromium and aluminum nitrates. The possibility of production of catalysts showing about 80% conversion of SO_2 (at 550°C) was pointed out. Some suggestions are given concerning the use of promotors. Author (ESRO)

N69-22381# Hungarian Academy of Sciences, Budapest. Technical Center for Hungarian Chemical Industry.

COMPUTERIZED OPTIMIZATION OF A SULFURIC ACID PLANT [OPTIMALIZATION D'UNE USINE D'ACIDE SULFURIQUE A L'AIDE D'UN ORDINATEUR ELECTRONIQUE]

Georges Honti *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 206–214 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary

Copyright. Avail: Edouard Privat, Toulouse

This research program is of a general nature and can be adapted to every process and every actual factory. The individual blocks are also universally applicable and can be adapted to the

actual conditions and data. In the case of calculations relating to a sulfuric acid factory, the only problem is that of the catalytic converter, and the corresponding optimization program has been drawn up. A simplified version, used for checking purposes without optimization, enables the activity of the catalyst to be calculated as a function of the data relating to temperature, concentration and linear velocity measured in the converter. Working with industrial and laboratory measurements, this program has been used to check the validity of a large number of kinetic equations. The results of these calculations are described. Author (ESRO)

N69-22382# Cambridge Univ. (England). Dept. of Chemical Engineering.
THE OXIDATION OF SULFUR DIOXIDE OVER MOLTEN SALTS
A. R. Glueck, F. P. B. Holroyd, and C. N. Kenney *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 215–217 (See N69-22351 11-06) refs
Copyright. Avail: Edouard Privat, Toulouse

Kinetic experiments on the oxidation of SO_2 over molten potassium pyrosulfate containing V_2O_5 are discussed. The rate of reaction is first order in sulfur dioxide and zero order in oxygen partial pressure. The velocity constant is 1.0×10^{-7} mole · cm^{-2} · $atm^{-1}sec^{-1}$ at atm^{-1}/sec^{-1} and the activation energy is 10 kcal. Possible mechanisms are given. Author (ESRO)

N69-22383# Academy Nauk SSSR, Novosibirsk.
PROCESS AND OPTIMUM CONDITIONS OF OXIDATION OF SULFUR DIOXIDE ON VANADIUM CATALYSTS [MECANISME ET CONDITIONS OPTIMA D'OXYDATION DU BIOXYDE DE SOUFRE DANS LES CATALYSEURS AU VANADIUM]
Guéorgui Boreskow *In* Toulouse Univ. Sulfur Oxides in Mod. Chem. 1968 p 221–231 (See N69-22351 11-06) refs In FRENCH; ENGLISH summary
Copyright. Avail: Edouard Privat, Toulouse

Under the conditions in which the SO_2 oxidation reaction takes place, the active portion of the vanadium catalysts is in the liquid state in solution in molten potassium pyrosulfate. This result is confirmed by 'thermographic' and 'derivatographic' studies of the $V_2O_5 + K_2SO_4$ in the catalyst at a temperature in excess of 470°C. Oxidation of SO_2 takes place according to the oxidoreduction mechanism, and the absorption of oxygen represents the boundary stage at temperatures below 540°C. This process is propagated in the liquid phase at a depth of about 600Å; this depth reduces with the temperature. These results have enabled the optimum pore structure of the vanadium catalysts to be determined. The change in the composition of the catalyst and its phase transformations as a function of the composition of the reaction mixture explain the complexity of the kinetic aspects of the SO_2 oxidation reaction. The variations in activation energy enabled the reaction velocity to be measured directly with different initial compositions of the reaction mixture. It has been shown that the kinetic equation proposed previously by Socolova and the author is no longer valid at low conversion rates; a new equation is put forward. The optimum conditions for the process of oxidation of SO_2 on vanadium catalysts have been established for reaction mixtures of different compositions. Author (ESRO)

N69-22394# Florida State Univ., Tallahassee.
THE EFFECTS OF THE QUANTITY AND PLACEMENT OF COPOLYMER UNITS WITHIN THE POLYMERIC CHAIN ON THE CRYSTALLIZATION PHENOMENA IN POLYMERS, PART 3 Technical Report, 1 May 1967–31 Aug. 1968
Leo Mandelkern Oct. 1968 38 p
(Contract AF 33(615)-3811)
(AD-681504; AFML-TR-66-160-Pt-3) Avail: CFSTI CSCL 7/4

The relations between the dissolution temperature, the crystallite thickness, and the crystallization temperature of linear polyethylene fractions crystallized from dilute solution are reported. The data are analyzed using equilibrium dissolution temperatures independently determined from investigations of the solubility properties of the bulk crystallized polymer which are also described. The interfacial free energy associated with the 001 basal plane, characteristic of the mature crystallites, differs from that involved in nucleation. From the most general considerations of nucleation theory, it is concluded that the interfacial structure of the nucleus is significantly different from that of the mature crystallite that develops from it. It is also established that the crystallite thickness is nucleation controlled, although details of the nucleation process itself and of the chain structure within the nucleus cannot be uniquely specified. Results on the thermodynamic and morphological properties of ordered copolymers of polyethylene oxide and poly-d, 1-propylene oxide crystallized from the melt and from dilute solution are reported. Author (TAB)

N69-22417# Commissariat à l'Energie Atomique, Pierrelatte (France). Direction des Matériaux et des Combustibles Nucléaires.
VOLATILE OXYFLUORIDE AND FLUORIDE DERIVATIVES OF CHROMIUM: CrO_2F_2, $CrOF_4$, CrF_5 AND CrF_6 [DERIVES VOLATILS OXYFLUORES ET FLUORES DU CHROME: CrO_2F_2–$CrOF_4$;CrF_5–(CrF_6)]
Louis Bethuel Jan. 1969 20 p refs In FRENCH; ENGLISH summary
(CEA-BIB-134) Avail: CFSTI

This bibliography on volatile chromium fluorides and oxyfluorides contains practically all that has been published up to December 31, 1967 concerning their preparation and their physical and chemical properties (53 references). Author (ESRO)

N69-22421# Lyon Univ. (France).
CONTRIBUTION TO THE STUDY OF THE TRANSFORMATIONS OF LEAD DIOXIDES [CONTRIBUTION A L'ETUDE DES TRANSFORMATIONS DES BIOXYDES DE PLOMB]
Daniel Fouqué (Ph.D. Thesis) 6 Mar. 1967 112 p refs In FRENCH
Avail: CFSTI

A survey is made of the literature on thermal differential analysis, the radioactive rare gas jet method and thermogravimetric methods all applied to the study of the thermal evolution of both α- and β- lead dioxide of different textures. A new technique has been developed and it is shown that the thermal stability of these dioxides are very different, the augmentation of the contact area acting adversely on stability. Intermediate decomposition products are analyzed and problems awaiting investigation are indicated. ESRO

N69-22432# Puerto Rico Nuclear Center, San Juan.
MATRIX ISOLATION STUDIES OF THE GAMMA-RADIOLYSIS OF HETEROCYCLIC MOLECULES
A. Grimison and G. A. Simpson Apr. 1968 57 p refs
(Contract AT(40-1)-1833)
(PRNC-116; TPR-3) Avail: CFSTI

Results are reported for studies on: absorption spectra of radiolytic intermediates at 77°K, luminescence of irradiated glassy solutions at 77°, electron spin resonance of radiolytic intermediates at 77°K, photochemistry of aromatic amines and heterocyclic compounds at 77°K, molecular orbital calculations, and valence

bond calculations. Data on the irradiated organic compounds are tabulated. A paper on the spectrophotometric identification of gamma radiolytic intermediates in a new halogenic glassy matrix is appended. The absorption spectra, dose dependence, and character of the intermediates produced by gamma radiolysis at 77 K of a 50-50 vol. % mixture of freon-11(CC1 F) and freon-11482 (CF_2BrCF_2Br) were determined. NSA

N69-22434# Commissariat a l'Energie Atomique, Grenoble, (France). Centre d'Etudes Nucleaires.
PREPARATION AND PHYSICO-CHEMICAL STUDY OF NITROXIDE RADICALS. ISOTOPIC MARKING WITH CARBON 13 AND DEUTERIUM [PREPARATIONS ET ETUDES PHYSICO-CHIMIQUES DE RADICAUX NITROXYDES. MARQUAGE ISOTOPIQUE AU CARBONE 13 ET AU DEUTERIUM]
Gilbert Chapelet-Letourneux (Ph.D. Thesis—Grenoble Univ., 17 Jul. 1967) Jan. 1969 107 p refs In FRENCH; ENGLISH summary
(CEA-R-3642) Avail: CFSTI

N-t-butyl-N-phenyl nitroxide is obtained by : a) action of t-butyl-magnesium chloride on nitrobenzene, or of phenyl-magnesium bromide on nitro-t-butane, b) oxidation of N-t-butyl-N-phenylhydroxylamine, c) oxidation of N-t-butylaniline. In the last two cases, it has been possible to isolate the pure radical and to study it using ultraviolet, infrared and electron paramagnetic resonance. It decomposes to give N-t-butylaniline and the N-oxide of N-t-butyl-p-quinonimine. The action of peracids as p-nitroperbenzoic or m-chloroperbenzoic acids on amines or hydroxylamines leads to the formation of stable or unstable nitroxide radicals easily observable by electron paramagnetic resonance. In order to obtain definite values for the coupling between the free electron of a nitroxide and carbon-13, the preparation of such radicals marked with ^{13}C in the α or β position of the nitroxide function was carried out. The coupling with an α carbon-13 is negative and does not appear to vary with the spin density on the nitrogen. The interaction with the β nuclei of the nitrogen depends on the nature of the substituents ; the two benzyl protons have a hyperfine splitting a_H which is always less than that of the ethyl. On the other hand, the ^{13}C coupling is greater in the first case. The usually adopted conformations for the compounds having the carbonyl group cannot account for the observed values of the β couplings. Author (ESRO)

N69-22468# Leeds Univ. (England). Dept. of Physical Chemistry.
CRITICAL EVALUATION OF RATE DATA FOR HOMOGENEOUS, GAS-PHASE REACTIONS OF INTEREST IN HIGH-TEMPERATURE SYSTEMS
D. L. Baulch, D. D. Drysdale, and A. C. Lloyd Nov. 1968 52 p refs Supported by Office for Sci. and Tech. Inform.
(REPT-2) Copyright. Avail: D. L. Baulch, Leeds Univ., Engl.

Available kinetic data are critically evaluated for some homogeneous gas-phase reactions involving hydrogen and oxygen at high temperature. Each section of the report deals with one reaction. The data are presented as follows: thermodynamic data, recommended value of rate constant, Arrhenius plot and tables of available data, discussion and references. Reactions considered are: $H_2O + O = OH + OH$; $OH + OH = H_2O + H$; $H_2O + M = H + OH + M$; $H + OH + M = H_2O + M$. ESRO

N69-22521# Atomics International, Canoga Park, Calif.
THE SOLUBILITY OF OXYGEN IN LIQUID SODIUM: A RECOMMENDED EXPRESSION
R. L. Eichelberger 1 Nov. 1968 21 p refs
(Contract AT(04-3)-701)
(AI-AEC-12685) Avail: CFSTI

The solubility of oxygen in sodium as reported in nine publications from eight laboratories was reviewed, and criteria established for the selection of data to be used to derive a recommended solubility curve. The recommended curve, based on 107 solubility determinations from five laboratories, is described by the equation: log S(wppM O) = 6.239 - 2447/T(°K). Author (NSA)

N69-22530# Oak Ridge National Lab., Tenn. Chemistry Div.
DIFFRACTION PATTERN AND STRUCTURE OF AQUEOUS AMMONIUM FLUORIDE SOLUTIONS
M. D. Danford Jun. 1968 42 p refs
(Contract W-7405-ENG-26)
(ORNL-4244) Avail: CFSTI

The scattering of x rays from the free surface of 1.18 and 10.87M solutions of ammonium fluoride in water was measured and analyzed at 25°C. Both the raw data and the intensity and radial distribution functions derived from them are presented in tabulated form. The data were interpreted in terms of the proposed model for pure liquid water. Experimental intensity and radial distribution functions are compared to those for water, along with theoretical intensity functions calculated from the model parameters. Author (NSA)

N69-22542# California Univ., Berkeley. Lawrence Radiation Lab.
SYNTHETIC STUDIES IN THE FIELD OF POLYENE COMPOUNDS. 24: SYNTHESIS OF POLYISOPRENOID KETONES: FARNESYLGERANYLGERANYLACETONES AND GERANYLGERANYLACETONES WITH THE APPLICATION OF THE WETTIG REACTION
E. A. Obolnikova et al Mar. 1968 16 p refs Transl. into ENGLISH from the book "Problemy Organicheskogo Sinteza" USSR, 1965 p. 49–55
(PB-180883T; UCRL-Trans-1373) Avail: CFSTI

A method was developed for lengthening the isoprenoid chain contained in ubiquinones by 5 and 10 carbon atoms using the Wettig's reaction. With this method farnesylacetone and geranylgeranylacetone were synthesized. With gas and fluid chromatography the ratios of the cis-isomers and trans-isomers of a number of studied compounds were determined. Author (USGRDR)

N69-22543# Utah Univ., Salt Lake City. Dept. of Metallurgy.
KINETIC STUDY OF THE SURFACE AREA CHANGE OF HEXANITROBENZENE DURING AGING
G. E. North, C. H. Pitt, and F. A. Olson 8 Aug. 1968 125 p refs
(PB-180875; TR-35C-CR-68-3716) Avail: CFSTI CSCL 07C

Surface area measurements of hexanitroazobenzene, HNAB, were performed using a sorptometer. The decrease in surface area with aging at various temperatures below the thermal decomposition temperature showed a log time dependence. The majority of the surface area was due to many small cracks formed by platelets which were agglomerated into larger particles of approximately 20 microns. Up to 193C the surface area decrease was found to be the result of the filling of the cracks of the agglomerate particles by the transport process of either surface diffusion or evaporation-condensation. The surface area decrease is dependent on the rate of material adsorbing in the cracks and was found to be due to 'fissure adsorption'. The range of crack widths active in filling was found to be a function of temperature, and the number of active cracks to be an exponential function of temperature. Above 193C shrinkage was observed and by using sintering theory the data indicates that the agglomerate particles were fusing together by the grain boundary diffusion model of material transport. Author (USGRDR)

N69-22645# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONTRIBUTION TO THE STUDY OF ISOTOPIC EXCHANGE OF OXYGEN BETWEEN NICKEL OXIDE AND THE GASES ARISING FROM THE OXIDATION REACTION OF CARBON MONOXIDE [CONTRIBUTION A L'ETUDE DE L'ECHANGE ISOTOPIQUE DE L'OXYGENE ENTRE L'OXYDE DE NICKEL ET LES GAZ DE LA REACTION D'OXYDATION DE L'OXYDE DE CARBONE]
Jean-Claude Bailly (Ph.D. Thesis—Lyon Univ.) Dec. 1967 101 p refs in FRENCH
(CEA-R-3191) Avail: CFSTI

The three isotopic reactions of oxygen: $C^{18}O + Ni_{16}O \rightleftarrows C^{16}O + Ni^{18}O$, $^{16}O^{18}O + Ni^{16}O \rightleftarrows {}^{16}O_2 + Ni^{18}O$, and $C^{16}O^{18}O + Ni^{16}O \rightleftarrows C^{16}O_2 + Ni^{18}O$ between CO, CO_2, O_2, and NiO were studied using a mass spectrometer. The isotopic gaseous mixtures were prepared from oxygen-18-enriched water. A first order kinetic law was found for these reactions in the gaseous phase, and the activation energies were determined. Only CO and CO_2 exchange oxygen, at room temperature, but only with part of the oxide surface. Gaseous O_2 reacts with the whole surface at 250°C. The slow step of the exchange process, in the gaseous phase, is mobility of oxygen ions on the surface of NiO. Author (NSA)

N69-22819# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
RAPID SEPARATION OF MIXTURES OF SOME ELEMENTS OF GROUPS 3–5 BY CONDENSATION AND ADSORPTION OF VOLATILE CHLORIDES FROM A GAS STREAM ON TEMPERATURE GRADIENT
T. S. Zvarova, Yu. T. Chuburkov, and I. Zvara 1968 16 p refs In RUSSIAN
(JINR-P6-4130) Avail: AEC Depository Libraries

Mixtures of elements (Nb, Ta, Hf, In) were chlorinated at about 450°C in a stream of nitrogen, saturated with thionyl chloride vapors in the presence of carbon. The gas mixture passed through a glass tube with the temperature falling along the gas path. Examples are given of separation of elements in micro- and macro-quantities in less than 30 min. The heat of adsorption for chlorides on the glass surface is estimated for various experimental conditions. Author (NSA)

N69-22824# Sandia Corp., Albuquerque, N. Mex.
COMMENTS ON FLASH PHOTOLYSIS AND TIME RESOLVED MASS SPECTROMETRY
Richard T. Meyer Jun. 1968 24 p refs
(SC-M-68-125) Avail: CFSTI

Information is presented on problems in instrumentation and kinetic analysis associated with flash photolysis studies by time resolved mass spectrometry. Topics included are flash lamp characteristics, electromagnetic interference, high pressure sampling, statistical fluctuations, transient species detection, and photolysis of NO_2, CO_2, and HCOOH. In addition, listings of papers on flash photolysis and time resolved mass spectrometry and laboratories engaged in time resolved mass spectrometry are included. Author (NSA)

N69-22886# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
CHEMICAL VAPOR DEPOSITION ON SILICON CARBIDE FROM SILICON TETRACHLORIDE METHANE HYDROGEN MIXTURES
J. E. Spruiell Dec. 1968 32 p refs
(Contract W-7405-ENG-26)
(ORNL-4326) Avail: CFSTI

The effect of deposition parameters on the characteristics of silicon carbide deposits was studied. The deposits were characterized by determining deposit density and soundness, phases present, surface appearance, hardness, and deposition rate. The variables found to have the greatest effects on deposit characteristics were deposition temperature and inlet gas stream composition. The surface morphology of the deposits varied, and the smoother deposits were associated with low deposition temperatures, fine-grained "laminar" microstructures, and the occurrence of free silicon. Although deposition temperature was most important, surface morphology was also a function of the inlet gas stream composition. The deposition rate was also a function of temperature and inlet gas stream composition. Typically, the deposition rate at 100 torr increased from about 5 to 10 mils/hr (thickness) at 1300°C to about 30 to 40 mils/hr at 1500°C. The hardnesses of the deposits were all very high even when the deposits contained as much as 65 vol % Si; the range was 1331 to 3855 dph (1 kg load) with higher hardnesses being associated with higher relative amounts of silicon carbide in the deposits. Author (NSA)

N69-22889*# Electrochimica Corp., Menlo Park, Calif.
NON-NOBLE METAL ELECTROCATALYSTS FOR FUEL CELLS Quarterly Status Report
20 Jan. 1969 14 p
(Contract NAS7-653)
(NASA-CR-100588; QTR-3) Avail: CFSTI CSCL 07B

The SIRED (semi-immersed rotating disc electrode device) was used to evaluate the polarization effect of spinel catalysts on substrate materials, and the results of each substrate material used are discussed. Complete data on all spinel compositions using acetylene black as a substrate were collected. The resistivity of each spinel composition was measured and the results are tabulated. B.G.D.

N69-22910# Oregon Univ., Eugene.
EXCHANGE REACTIONS CARBOXY RADICALS AND CARBOXYLATE ANIONS Final Report, Apr. 1965–Apr. 1968
T. Koenig Jan. 1969 5 p refs
(Contract DA-31-124-ARO(D)-389)
(AD-682018; AROD-5475.5-C) Avail: CFSTI CSCL 7/3

The article briefly summarizes the problems centered around the detailed mechanisms of the decompositions of peroxide molecules. The methods of study included secondary deuterium kinetic isotope effects. Further study of these isotope effects on the decomposition of acetyl peroxide and the decarbosylation of the acetoxy radical intermediate were also carried out. The results indicated that the isotope effect on the decarboxylation of the acetoxy radical was 1.03 per deuterium. The isotope effect on the overall destruction of this peroxide was also found to be viscosity sensitive (1.03 in isooctane and 1.05 in nujol). These values are consistent with an overall picture for the reaction which allows for reversible acetoxy radical formation with diffusive separation and decarboxylation competing in the forward direction. Author (TAB)

N69-22972# Brown Univ., Providence, R. I. Div. of Engineering.
PREPARATION AND PROPERTIES OF NEW MAGNETIC TRANSITION METAL CHALCOGENIDES Final Report, 15 Feb. 1966–31 Jan. 1969
Aaron Wold Jan. 1969 6 p refs
(Contract DA-31-124-ARO(D)-433)
(AD-682017; AROD-6079.9-MC) Avail: CFSTI CSCL 7/2

This report states the postulated goals of research conducted on metal chalcogenides. A list of the results and published reports are also given. TAB

N69-22991*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF LIGHT-SCATTERING DATA FROM POLYMER SOLUTIONS
James A. Ryan Washington Apr. 1969 18 p refs
(NASA-TN-D-5177) Avail: CFSTI CSCL 07D

An analysis was made of various factors affecting the analytical fitting of curves to a Zimm plot of light scattering data from dilute polymer solutions. The use of a computer to completely fit the data analytically was not feasible. However, a procedure was developed whereby the computer calculates the points on the limiting tangent. This tangent is then extrapolated graphically to zero concentration. A computer program was written which incorporates this method. Author

N69-23005# Atomic Energy Commission, Washington, D. C.
SECOND INTERNATIONAL CONFERENCE ON LUMINESCENCE DOSIMETRY
J. A. Auxier, ed., K. Becker, ed., and E. M. Robinson, ed. [1968] 978 p refs Meeting held at Gatlinburg, Tenn., 23–26 Sep. 1968
(Conf-680920) Avail: CFSTI

Radiophotoluminescence and thermoluminescence are discussed, along with such related topics as exoelectron emission, supralinearity, mechanisms of trapping, types of centers involved, and some less common luminescence substances such as lithium borate. For individual titles, see N69-23006 through N69-23078.

N69-23006# Matsushita Electric Industrial Co., Ltd., Osaka (Japan). Central Research Lab.
CALCIUM SULFATE PHOSPHOR ACTIVATED BY RARE EARTH
T. Yamashita, N. Nada, H. Onishi, and S. Kitamura *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 4–17 refs (See N69-23005 11-06)
Avail: CFSTI

$CaSO_4$ crystals activated by rare earth elements were found to be free from the serious disadvantage of rapid fading in $CaSO_4$:Mn while retaining the outstanding property of high sensitivity of $CaSO_4$:Mn, the most sensitive thermoluminescence dosimeter available at present. Among fourteen kinds of phosphors tested, $CaSO_4$:Dy and $CaSO_4$:Tm showed the highest sensitivity with essentially a single glow peak at about 220°C. Emission spectrum of $CaSO_4$:Tm consists of a main sharp at 450 mμ with minor ones at 360, 470 and 520 mμ. $CaSO_4$:Dy has two main peaks at 480 and 570 mμ without any minor one. Except for their non-tissue equivalence, the dosimetric characteristics of $CaSO_4$:Dy and $CaSO_4$:Tm are excellent: (1) little fading, (2) minimal detectable exposure lower than 500 μ R with standard deviation of ± 20%, (3) linear dose response up to 3×10^3 R, superlinear from 3×10^3 to 10^4 R, and tendency to saturation around 10^5 R, (4) very low tribothermoluminescence, (5) high resistance against various spurious effects, such as sun beam, artificial light, ambient gases, and (6) constant thermoluminescence efficiency for more than 100 times of irradiation after repeated heating to erase previous dose. Author

N69-23008# Dai Nippon Toryo Co., Ltd., Chigasaki (Japan). Research Dept.
THERMOLUMINESCENCE OF Y_2O_3-Al_2O_3:Tb PHOSPHORS
Hiroshi Sakamoto, Teiichi Hitomi, and Noboru Kotera *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 27–42 (See N69-23005 11-06)
Avail: CFSTI

New phosphors with compositions of Y_2O_3-Al_2O_3:Tb have been developed, which are utilizable in thermoluminescence dosimetry. Effects on thermoluminescence of composition, Tb concentration, and other preparative conditions are investigated. Thermoluminescent properties of resultant phosphors are described and discussed with regard to the nature of luminescence centers and trapping states included. It is identified that Tb ions cause the main glow peak of nearly 150°C, while residual Eu ions are responsible for the subpeak of 80°C. In Y_2O_3-0.5Al_2O_3:Tb (2 × 10^{-4} g - atm), one of the typical phosphors in this series, dependency of the intensity of thermoluminescence upon exposure keeps a linear relationship over a wide range or more than six orders of magnitude, where the lowest limit of detectable exposure is below 1mR. Author

N69-23009# Wisconsin Univ., Madison. Dept. of Radiology.
DOSIMETRIC PROPERTIES OF CaF_2:Dy
W. Binder, S. Disterhoft, J. R. Cameron *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 43–53 (See N69-23005 11-06)
(Contract AT(11-1)-1105)
Avail: CFSTI

The general dosimetric properties of CaF_2:Dy (thermoluminescent dosimeter (TLD-200) were investigated. Studies were carried out on eight different batches. The last five batches showed quite uniform characteristics. The glow curve structure and peak temperatures are given. The theirmoluminescence (TL) response was studied up to 10^6 R. The relative heights of the peaks in the flow curve change with the exposure level and radiation quality. The TL-emission spectrum has peaks at 4800Å, 4835Å, and 5765Å. Depending on the readout system, TLD-200 was found to be 15 to 30 times more sensitive than TLD-100 on an integrated TL basis. Some annealing characteristics are given, and the stability is discussed. TLD-200 shows energy dependence, which was studied from 20 keV effective to 1250 keV effective. Author

N69-23010# Nara Univ. (Japan).
APPLICATION OF RADIOTHERMOLUMINESCENCE OF SOME PHOSPHORS TO ACCIDENT DOSIMETRY
R. Huzimura and Y. Ato (Govt. Ind. Res. Inst., Nagoya, Japan) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 54–59 refs (See N69-23005 11-06)
Avail: CFSTI

The thermoluminescence (TL) of such phosphors as Y_2O_3:Eu/Sm and 5CaF_2 - Y_2O_3:Eu shows one or two resolved glow peaks at 60 to 130°C. The growth of the TL peak height under irradiation with ^{60}Co γ-rays at low levels, 0.6 and 6 mR/h, and fading after an irradiation to 100 R were studied. By use of the TL peaks of these phosphors, the accident dosimetry is possible at various periods of monitoring and storage times between the accident and the time of measurement. The typical lower limit of dose to obtain a signal ten times larger than the accumulated background is 1.9 R with Y_2O_3:Eu two hours after the irradiation, if the monitoring period before the irradiation was ten days at a background level of 6 mR/h. Author

N69-23013# Western Kentucky Univ., Bowling Green.
THE CHARACTERISTICS OF RUBY AS A THERMOLUMINESCENT RADIATION DOSIMETER
W. G. Buckman, C. R. Philbrick (USAF), and N. Underwood (North Carolina Univ.) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 82–88 refs (See N69-23005 11-09)
(Grant PHS RH00536-01)
Avail: CFSTI

The thermoluminescence of different ruby crystals is presented. Comparisons are made with the thermoluminescence dosimeter (TLD)-100 powder. The ruby, with low chromium concentration, is

shown to have a rather simple glow curve which peaks at 170°C after a simple annealing procedure and to be as sensitive as the specially annealed TLD-100. It is suggested that ruby can be utilized as a practical radiation dosimeter, including the near ultraviolet, and that it can be used in tandem with TLD-100 powder to yield information concerning the energy of the X or gamma-radiation exposure. Author

N69-23016# Purdue Univ., Lafayette, Ind. Bionucleonics Dept.
STUDIES ON THE THERMOLUMINESCENCE OF MANGANESE ACTIVATED LITHIUM BORATE
R. H. Wallace and P. L. Ziemer *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 140–147 refs (See N69-23005 11-06)
Avail: CFSTI

Manganese activated lithium borate ($Li_2B_4O_7$) powder was studied to determine the effects on thermoluminescence response for variations in percentage manganese impurity, particle size, pre-irradiation annealing, and post-irradiation storage conditions. All of these parameters were found to affect the light output from lithium borate dosimeters exposed to gamma rays. Fast and thermal neutron sensitivities of lithium borate were determined, and the effects of fast neutron irradiation on the response to gamma rays were studied. Author

N69-23017# Oak Ridge National Lab., Tenn. Health Physics Div.
LOW-Z RADIOPHOTOLUMINESCENT GLASSES BASED ON LITHIUM BORATE
K. Becker and J. S. Cheka *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 148–160 refs (See N69-23005 11-06)
Avail: CFSTI

A radiophotoluminescent silver-activated glass based on the $Li_2O.B_2O_3$ system instead of the usual metaphosphate matrix was investigated. By reduction of the amount of silver activator, glasses with an energy dependence comparable to LiF were prepared. Maximum radiophotoluminescence is developed by a heat treatment. The new dosimeters exhibit good stability even at high temperatures (up to 350°C). The uv absorption spectrum induced by high radiation doses is more complex than in phosphate glasses. The absorption at some wavelengths, in particular below 300 nm, is considerably more stable than the most stable absorption band in phosphate glasses at 315 nm. The humidity resistance and sensitivity of lithium borate glasses can be increased by additions of BeO. Author

N69-23018# Wisconsin Univ., Madison. Dept. of Radiology.
DOMESTIC PROPERTIES OF LITHIUM TETRABORATE: MANGANESE (HARSHAW)
Charles R. Wilson and John R. Cameron *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 161–175 refs (See N69-23005 11-06)
(Contract AT(11-1)-1105; Grant NIH T1-CA-5105-07-RAD)
Avail: CFSTI

The dosimetric properties of the thermoluminescent phosphor $Li_2B_4O_7$:Mn were investigated. Two different batches were studied. The response curves and glow curve structure of the batches are given for the range of 10 to 10^6 R. Fading characteristics, emission spectrum, and energy dependence are discussed. Author

N69-23021# Czechoslovak Academy of Sciences, Prague. Nuclear Research Inst.
ELECTRONEXOEMISSION (EE) AND THERMOLUMINESCENCE (TL) FROM DOPED CALCIUM SULPHATE CRYSTALS
Z. Spurny, J. Novotny, and H. Holohlavska *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 220–233 refs (See N69-23005 11-06)
Avail: CFSTI

Using a laboratory type of reading system, thermoluminescence and exoelectron emission effects were measured simultaneously in $CaSO_4$ crystals activated with about twenty different elements. Phosphors showing a strong TL effect usually give a well developed EE curve. On the other hand, some other phosphors do not behave in this way; they have no TL effect, but have a well developed EE. Experimental results are described. TL activity was detected for about 17 phosphors; the best results were obtained for $CaSO_4$(Mn), $CaSO_4$(Sm) and $CaSO_4$(Mg). The EE effect was registered for 13 phosphors, with the best one being $CaSO_4$(Pb). Author

N69-23022# Pennsylvania State Univ., Univ. Park. Materials Research Lab.
RECENT EXPERIMENTS ON X-RAY AND UV DOSIMETRY BY MEANS OF NON-LUMINESCENT CRYSTALS
H. K. Henisch and D. N. Bose *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 234–242 refs Sponsored by AEC (See N69-23005 11-06)
Avail: CFSTI

A survey is given of recent research on the dosimetric capabilities of thermally or radiatively stimulated current glow, and of pyroelectric processes. The materials used are zinc sulfide, diamond, and tourmaline. The studies suggest that making commercially viable devices along these lines may be feasible. In addition, the measurements can be used for the characterization of materials which, by virtue of their low conductivity, do not yield to orthodox methods. Author

N69-23031# Wisconsin Univ., Madison. Dept. of Radiology.
SUPRALINEARITY OF THERMOLUMINESCENT PHOSPHORS
John R. Cameron, N. Suntharalingam, Charles R. Wilson, and S. Watanabe (Inst. de Energia Atomica, Sao Paulo, Brazil) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 332–340 refs (See N69-23005 11-06)
(Contract AT(11-1)-1105; Grant PHS T01-CA-05104-07-RAD)
Avail: CFSTI

The TL response of many phosphors exhibits a supralinear behavior. A satisfactory explanation of this phenomenon could help in the understanding of TL in general. A model of supralinearity is discussed which assumes the presence of a competing trap with a larger cross-section for capture of electrons than the normal dosimetry traps. This model qualitatively explains the experimentally observed properties of LiF (TLD-100). The mathematical formulation gives a reasonable agreement to the experimental TI vs R curves of LiF (TLD-100) and $Li_2B_4O_7$:Mn. Author

N69-23034# Oxford Univ. (England). Research Lab. for Archaeology.
PREDOSE EFFECTS IN THERMOLUMINESCENCE AND IN LUMINESCENCE DURING IRRADIATION
M. J. Aitken, Joan Thompson, and S. J. Fleming *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 364–388 refs (See N69-23005 11-06)
Avail: CFSTI

The acquisition of thermoluminescence by some phosphors is a supralinear function of radiation dose, and often associated with this is the enhancement of thermoluminescence sensitivity by a factor that is dependent on the dose received prior to the last readout. Various kinetic models are proposed for observations made on quarts. In addition to thermoluminescence measurements, a study was made with a number of phosphors (including natural CaF_2, LiF, $CaSO_4$) and on the extent to which radioluminescence exhibits pre-dose effects, both at room temperature and at elevated temperatures. The luminescence observed is dependent on temperature and usually reaches a maximum a little above the flow peak temperature and at elevated temperatures. The luminescence observed is dependent on temperature and usually reaches a maximum a little above the glow peak temperature. In some cases (e.g., LiF and CaF_2) the luminescence is enhanced when the material has been predosed; the significance of this with respect to various models is discussed. The measurements reported utilized beta particles from a $^{90}Sr-^{90}Y$ equilibrium source. Author

N69-23050# Denison Univ., Granville, Ohio.
COMPUTER ASSISTED THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE THERMOLUMINESCENCE OF LiF:Mg
R. M. Grant, Jr., W. S. Stowe, and J. Correll *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 613–622 refs (See N69-23005 11-06)
Avail: CFSTI

The theoretical application of the Randall–Wilkins model of thermoluminescence (TL) to the irradiation induced TL glow peaks of LiF:Mg was studied utilizing computer assisted analysis techniques. The structure of a single glow peak (its peak position and full-width at half-maximum) is shown to depend on three independent parameters: the heating rate, β; the trap depth, E; and the frequency factor associated with the trap, S. Experimental apparatus utilizing an analog to digital converter and a 512 channel analyzer to collect and store data directly in digital format is described. Successful application of curve fitting techniques to the analysis of the TL of LiF:Mg (70 ppm) is found to yield the following parameters for the 5 glow peaks making up the glow curve: (1) 0.82ev, 5×10^{11} sec^{-1}; (2) 1.08ev, 2×10^{13} sec^{-1}; (3) 1.13ev, 5×10^{12} sec^{-1}; (4) 1.15ev, 1.2×10^{12} sec^{-1}; (5) 1.36ev, 2.2×10^{13} sec^{-1}. Peaks one and two decay at room temperature, while three through five show no change after 24 hours. Author

N69-23051# Argonne National Lab., Ill. Radiological Physics Div.
SPECTRAL ANALYSIS OF THERMOLUMINESCENCE GLOW CURVES
B. G. Oltman, J. Kastner, and C. Paden *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 623–631 refs (See N69-23005 11-06)
Avail: CFSTI

An effort was made to correlate the spectrum of the light from TL materials, including the far uv, with various kinds of ionizing radiations. An apparatus is described which was designed and constructed to provide well-controlled heating ramps and monochromator scanning capability. Results are given for such analysis for various inorganic TL materials. Author

N69-23080 Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse.
2 θ-VALUES FOR THE X-RAY SPECTRUM ANALYSIS WITH AMMONIUM DIHYDROPHOSPHATE, (011), 2 d = 10.648 Å AS ANALYZER CRYSTAL [2 θ-WERTE FUER DIE ROENTGENSPEKTRALANALYSE MIT AMMONIUM DIHYDROPHOSPHAT, (011), 2 d = 10.648 Å ALS ANALYSATORKRISTALL]
C. Freiburg and W. Reichert Jun. 1968 87 p refs In GERMAN (JUL-531-CA) Avail: CFSTI

Computer printout tables are presented, with the 2 θ values arranged first in order of increasing wavelength, and then rearranged in order of increasing atomic number of the elements. Transl. by K.W.

N69-23088# California Univ., Berkeley. Lawrence Radiation Lab.
INVESTIGATION OF THE IONIZATION AND DISCHARGE OF METAL IONS BY MEANS OF RADIOACTIVE INDICATORS
V. V. Losev May 1968 14 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 100, 1955 p 111–114 In ENGLISH and RUSSIAN
(PB-180855T; UCRL-Trans-1376) Avail: CFSTI

In the investigation of the rates of electrochemical processes by way of polarization measurements, only the difference between anodic and cathodic rates lends itself to determination. For instance, the intensity of the cathodically polarizing current does express with sufficient accuracy the intrinsic rate of the cathodic process only at potentials sufficiently removed from the equilibrium potential. In the neighborhood of this potential, however, where the rate of the simultaneous anodic process gradually approaches that of the cathodic process, the intensity of the cathodic current is not a measure anymore of the intrinsic rate of the cathodic process, i.e., the discharge of metal ions. Under these conditions the intrinsic rate of a given electrode process can only be measured by means of isotope tracers. Author (USGRDR)

N69-23095# United Kingdom Atomic Energy Authority, Windscale (England).
THE PREPARATION AND PROPERTIES OF THERMOLUMINESCENT LITHIUM BORATE
R. T. Brunskill 1968 23 p refs
(PG-837(W)) Avail: CFSTI; UK 4s

A consistently sensitive thermoluminescent lithium borate has been made by melting a molecular proportioned mixture of boric acid and lithium carbonate in an argon atmosphere. The material is twice as sensitive as the commercially available product. Lithium borate requires no heat treatment after readout and before re-use and its dose response to γ radiation in the energy range 17 to 100 keV is within 10% of tissue equivalent. By simple modifications to the reading unit, the total background arising from the heating of undosed powder, is only 3 to 4 Mrad. In neutron free areas there are clear technical advantages in the use of lithium borate for the measurement of $\beta\gamma$ and γ doses. NSA

N69-23138*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
METHOD FOR VISUALIZING ISOTHERMAL SURFACES
Yu. N. Vorontsov et al Washington NASA Apr. 1969 5 p refs Transl. into ENGLISH from "Svoystva Gazov Pri Vysokikh Temperaturakh" Moscow, Nauka, 1967 p 181–183
(Contract NASw-1692)
(NASA-TT-F-12218) Avail: CFSTI CSCL 07D

A supersonic wind tunnel investigation is made, aimed at visualizing the propagation of a heat front in a solid body under conditions where the surface geometery of the body is not impaired. Photographs are shown of the consecutive phases of the motion of an isothermal surface, obtained with spherical Teflon models at temperatures on the order of 800°K and at M = 2.8. Author

N69-23189# Los Alamos Scientific Lab., N. Mex.
INTEGRAL FULL-FLOW VACUUM DISTILLATION SAMPLING SYSTEM FOR USE IN A HIGH TEMPERATURE RADIOACTIVE SODIUM ENVIRONMENT
V. J. Rutkauskas [1968] 15 p refs Presented at Conf. on Sodium Technol. and Large Fast Reactor Design, Argonne, Ill.
(Contract W-7405-ENG-36)
(LA-DC-9666; Conf-681106-3) Avail: CFSTI

A laboratory model is currently being used for the routine analysis of O_2 in experimental dynamic Na systems. This analytical method has a precision of ±0.5 ppm in the O_2 concentration range of 1 to 10 ppm and the time required for a completed analysis is approximately 2 hours. The design of the laboratory system is being modified to enable it to be used in a radioactive Na environment at LMFBR temperature conditions. The entire system is constructed of Type 304 stainless steel and the separation of Na from the nonvolatile impurities is accomplished with a high frequency induction generator located within the metal envelope of the distillation zone. The system design eliminates the need for sample transfer. The full-flow vacuum distallation sampling system is designed for the routine removal of Na samples for O_2 analysis and it has the potential for being used to identify other species present in a radioactive Na environment. Author (NSA)

N69-23200# Brookhaven National Lab., Upton, N. Y.
REACTION OF HCl WITH LIQUID SODIUM AND A SODIUM BARIUM ALLOY
M. R. Hobdell and L. Newman 1 Nov. 1968 34 p refs Presented at the Conf. on Sodium Technol. and Large Fast Reactor Design, Argonne, Ill.
(BNL-13063; Conf-681106) Avail: CFSTI

The reaction of HCl with pure sodium and sodium containing dissolved barium is described. In both cases the reaction took place in two separate steps: $HCl \rightarrow {}^1/_2H_2 + Cl^-$ and ${}^1/_2H_2 \rightarrow H^-$. The effect of barium was to decrease the rate of hydrogen production, while increasing that of hydrogen uptake. The formation of molecular hydrogen was controlled by processes of a physical nature. The rate-determining step for hydrogen absorption, however, apparently involved the adsorption and dissociation of hydrogen molecules at the metal surface. Author (NSA)

N69-23248# Kernforschungszentrum, Karlsruhe (West Germany).
INVESTIGATION OF THE REACTION OF LIQUID HYDROGEN WITH LIQUID AIR IN A PRESSURE TUBE [VERSUCHE UEBER DIE REAKTION VON FLUESSIGEM WASSERSTOFF MIT FLUESSIGER LUFT IM EINEM DRUCKROR]
Erich H. Karb Jul. 1968 58 p refs in GERMAN
(KFK-789) Avail: AEC Depository Libraries

A pressure tube should protect the FR-2 reactor from the consequences of a hydrogen-air reaction, which is conceivable in the breakdown of several safety devices of the planned cold neutron source Project FR-2/16. The magnitudes and time pattern of the pressures to be expected were investigated. In the geometry used and the ignition mechanism selected, which is comparable with the strongest ignition process conceivable in the reactor, the reaction proceeds with greater probability than combusion. The combustion is possibly smaller if local limited partial detonations are superimposed. The magnitude of the pressure was determined by the masses of the reaction partners, liquid H_2 and liquid air, and determines their ratio to each other. Author (NSA)

N69-23252# Atlantic Richfield Hanford Co., Richland, Wash.
THE DETERMINATION OF GALLIUM IN PLUTONIUM BY ATOMIC ABSORPTION
A. G. Miller 7 Jun. 1968 12 p refs
(Contract AT(45-1)-2130)
(ARH-SA-13) Avail: CFSTI

An atomic absorption method was investigated for determination of gallium in plutonium. The extraction of gallium by 5% Aliquat 336 in methyl isobutyl ketone was demonstrated to be quantitative for conditions encountered in this application. The precision was not so good as that possible with the fluorimetric method. (NSA)

N69-23297# Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France).
KINETIC STUDY OF THE REDUCTION OF HEXAVALENT PLUTONIUM BY HYDROGEN PEROXIDE IN ACID SOLUTION
Bernard Lesigne (Ph.D. Thesis) Dec. 1967 39 p refs Transl. into ENGLISH from French Report CEA-R-3168
(CEA-R-3168; RFP-Trans-47) Avail: CFSTI

The kinetics of the reduction of hexavalent plutonium by hydrogen peroxide was studied in perchloric, sulfuric, and nitric acids. The rate of reduction is proportional to the initial concentrations of plutonium and of hydrogen peroxide and is inversely proportional to the acidity. The values of the proportionality constant k were determined. They are very dependent on the temperature, on the ionic force, and on the nature of the anion of the acid medium. An interpretation is put forward, based on the experimental results, attributing an important role to the hydrolyzed species $PuO_2(OH)^+$ in the reduction kinetics. Author (NSA)

N69-23341# California Univ., Berkeley. Lawrence Radiation Lab.
PRECISION ATOMIC BEAM STUDIES OF THE ZEEMAN EFFECT IN THALLIUM AND GALLIUM (ELECTRONIC AND NUCLEAR MAGNETIC MOMENTS)
Thomas Richard Fowler (Ph.D. Thesis) 1 Aug. 1968 109 p refs
(Contract W-7405-eng-48)
(UCRL-18331; PB-180885) Avail: CFSTI CSCL 7/4

The atomic beam method was used to measure the electronic and nuclear magnetic moments and the off-diagonal dipole interaction constants of gallium and thallium in both the ground state, (2)P1/2, and the metastable state, (2)P3/2. Also, the previous measurement of the hyperfine interaction constants by Holloway have been re-analyzed. Both thallium isotopes (203 and 205) were measured to check for possible isotope shifts as Z = 81; none were found. Author (USGRDR)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-21969# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PULSE FREQUENCY DISCRIMINATOR
Sh. M. Chabdarov Aug. 1968 10 p refs Transl. into ENGLISH from Aviats. Inst. Kazan. Tr. (USSR), no. 92, 1966 p 82-85
(AD-681609; FTD-MT-24-206-68) Avail: CFSTI CSCL 9/5

A frequency discriminator designed to determine the carrier frequency or duty cycle of short bursts of radio signals is presented.

it gives a discrimination characteristic with steep slope, and also reduces the coupling between the discrimination and transient characteristics of existing devices. It uses (for transforming the frequency change to a voltage change) the slope of the envelope of the frequency spectrum of amplitudes with rectangular frequency characteristics of the filter. The use of this method is desirable with input signals of short bursts. This pulse frequency discriminator is analyzed, using Fourier transforms, by studying the analogy between it and a pulse time discriminator. The output signal of the frequency discriminator is formed by subtracting the symmetrically tuned filter response at the input. In the time discriminator, the output is presented by the difference of the input and gating pulses with a symmetrical time shift. The output signals of the frequency discriminator. With symmetrical tuning, the orthogonal component of the filter can be neglected, and the output signal is considered proportional to the difference of the in-phase components. Thus, this discriminator is an application of synchronous detection.
Author (TAB)

N69-21997 Arizona Univ., Tucson
A GENERAL METHOD OF COHERENT DEMODULATION WITH APPLICATIONS
Jerome Adolphus Camp (Ph.D. Thesis) 1968 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-14511

A preliminary investigation was conducted of a coherent demodulation scheme in which the information signal to be conveyed is passed through a general linear filter prior to transmission. Conventional schemes for demodulating phase and frequency modulated signals are special cases of the general system investigated here. To establish the feasibility of this approach, it is necessary to consider a particular version of the general case. The scheme which suggested itself, and which is investigated, is one in which information about the message signal and its derivative is conveyed. This is a combination of conventional PM and FM schemes and corresponds to combination of the information signal and its derivative prior to transmission. An additional scheme is also examined in which the combination of the information signal and its derivative takes place after transmission, but this is only a variation of the basic scheme of combination before transmission.
Dissert. Abstr.

N69-22051 Iowa Univ., Iowa City.
A CLASS OF CONVOLUTIONAL CODES AND A NEW DECODING ALGORITHM
Sudhakar Mannapuram Reddy (Ph.D. Thesis) 1968 88 p
Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-10685

The problem investigated in this dissertation is the nature of the convolutional codes generated by convolutional encoders made up of a shift register and a block code encoder. The error correcting capability of these codes under various decoding modes is investigated. A new decoding algorithm which realizes the guaranteed independent-error correcting capability, under some decoding modes, is given. The error propagation property of these codes is also studied and it is shown that limited error propagation can be achieved when decoded with slightly reduced capability. The codes have encoding and in most cases error correcting capability advantage over the known convolutional codes of the same transmission rate. Over all the approach taken has resulted in good short and low rate convolutional codes.
Dissert. Abstr.

N69-22180*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A HIGH-RATE TELEMETRY SYSTEM FOR THE MARINER MARS 1969 MISSION
R. C. Tausworthe, M. F. Easterling, and A. J. Spear 1 Apr. 1968 28 p refs
(Contract NAS7-100)
(NASA-CR-100550; JPL-TR-32-1354) Avail: CFSTI CSCL 09F

The rationale, analysis, and hardware development of a multi-mission, deep space system are described, along with its subsequent planned application to an actual spacecraft mission, the Mariner Mars 1969 flight whose preparation is in progress. The spacecraft system encodes raw binary data into a comms-free, biorthogonal code that antipodally modulates a square-wave subcarrier. In turn, this subcarrier phase-modulates the downlink carrier. Separate signals are not required for subcarrier, word, or symbol sync; all transmitted sideband power is thus available for data transmission. System design and actual data are presented. These data were taken at several levels of system design and functional verification, including some of the spacecraft performance tests.
Author

N69-22170 California Univ., Berkeley.
THE E-CAPACITY OF CLASSES OF UNKNOWN CHANNELS
Leonard John Forys (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-13903

Classes of channels are considered which can be described as follows. A transmitted signal x and a received signal y are column vectors of dimension p, with real valued components and are related by $y = A\gamma x$ where $A\gamma$ is a pxp real valued matrix selected from a bounded class of such matrices i.e., $|A\gamma| < a$, for all $A\gamma \epsilon A\gamma$ denotes both a matrix and a channel. The n-extension of a channel carries n-sequences of p-dimensional input vectors into n-sequences of p-dimensional output vectors according to the rule.
Dissert. Abstr.

N69-22208*# Texas Univ., Austin. Information Systems Research Lab.
DIGITAL MATCHED FILTERS FOR DETECTING GAUSSIAN SIGNALS IN GAUSSIAN NOISE
T. L. Henderson and D. G. Lainiotis 12 Sep. 1968 19 p refs
(GRANTS NGR-44-012-066; AF-AFOSR-67-768A)
(NASA-CR-100576; AD-679606; TM-3) Avail: CFSTI CSCL 17B

The use of a set of digital matched filters is presented as an alternative to direct computation of the likelihood-ratio, for the problem of detecting a random signal in random noise. It is assumed that a random process composed of Gaussian background noise and (with probability P) a zero-mean Gaussian signal is sampled at N instants, the samples being corrupted by additive Gaussian measurement noise. The samples are processed by $K << N$ digital correlation filters which are structured so that the signal can be detected with minimum Bayes risk. The optimum filters are shown to be matched to the most relevant components of the simultaneously orthogonal expansion of the set of sampled data. State variable techniques are used to find a very practical method for determining the optimum filter structures.
Author (TAB)

N69-22288*# Texas Univ., Austin. Electrical Engineering Research Lab.
OBSERVATIONS OF LOW ALTITUDE CLEAR AIR TARGETS
A. P. Deam, A. B. Plunkett, and A. H. LaGrone Aug. 1968 63 p
(Grant NSF GA-772)
(PB-180674; P-30) Avail: CFSTI CSCL 17I

A radar system for detecting and analyzing radar returns from the clear atmosphere is discussed. Analysis of the type of radar returns to be expected from various types of meteorological targets including clouds and disturbed refractive index is carried out. The radar performance with these types of targets is calculated theoretically and experimental data is presented which shows the actual types and character of returns as expected.
Author (USGRDR)

N69-22270# Weather Bureau, Sterling, Va. Test and Evaluation Lab.
TEST AND EVALUATION OF THE VIDEO INTEGRATOR AND PROCESSOR Final Report
Robert C. Strickler Apr. 1968 76 p
(PB-180765; WBTM-T/EL-5) Avail: CFSTI CSCL 17B

The Video Integrator and Processor (VIP), a contouring device for the WSR-57 weather radar, was tested and evaluated at the Washington National Airport (WNA) Weather Station during the period February to July 1967 for the purpose of determining its overall suitability for field implementation by the Weather Bureau. Test objectives, approach, and results are described. The accuracy of the Radar/VIP transfer functions were studied in detail and data indicate an overall system accuracy at the 0.95 probability limits of 5 dbm. The VIP displays was favorably received by the radar meteorologists at WNA and the equipment was found to be very reliable. Author (USGRDR)

N69-22292# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
LARGE APERTURE ANTENNA ANALYSIS
John W. Sherman Jun. 1968 88 p refs
(Contract DAHC15-67-C-0011)
(AD-682211; IDA/HQ-67-6994; RP-P-384) Avail: CFSTI CSCL 9/5

The paper presents an analysis of the relationship which exists between the illumination of electromagnetic energy across a large antenna aperture and the radiated field which results. The approach taken is one which emphasizes the similarity of radiating apertures rather than the differences between such structures. No regard is given to the manner in which the aperture illumination of energy is obtained, but many of the illuminations considered are those associated with the customary use of reflector, phased array, and lens configurations. The application of Fourier, Hankel, and Lambda transform theories to diffraction theory is given, including appropriate limitations. Lambda functions are used to define the far-field patterns. Phase and amplitude effects of a priori illuminations include both the Chebyshev-Taylor control of sidelobes with respect to beamwidth and the recently introduced energy optimization concepts used in optics. The effects of errors, aperture blocking, and broadband and transient antenna response on the far-field pattern are included. Author (TAB)

N69-22411# Hydro-Space Systems Corp., Cedar Rapids, Iowa.
SOLID STATE VHF OMNI RANGE TRANSMITTER Final Report
D. L. Fredrickson Dec. 1968 61 p
(Contract FA-67-WA-1745)
(RD-68-65) Avail: Issuing Activity

The design objective was to develop a 100 watt all solid state VOR transmitter capable of either doppler or conventional VOR operation. A solid state keyer was also developed to work in conjunction with the transmitter. The program has culminated with the development of a small, low power drain, modularized, highly reliable system which meets all major design objectives. The RF unit chassis integrates the power supply, exciter, modulator, power amplifier, and audio circuits into one unit occupying approximately 1.5 cubit feet. The circuitry used in this chassis eliminates the need for external power splitter and modulation eliminator as used with older equipments. Author

N69-22512*# Techtran Corp., Glen Burnie, Md.
RADIO ELECTRONICS AND PROBLEMS OF ARTIFICIAL EARTH SATELLITES [RADIOELEKTRONIKA I PROBLEMA ISKUSSTVENNOGO SPUTNIKA ZEMLI]
A. I. Berg, ed. et al Washington NASA Apr. 1969 5 p Transl. into ENGLISH from the publ. "Radiotekhnika i Elektronika i Ikh Technicheskoy Primeneniye" Moscow, USSR Acad. of Sci. Press, 1956 p 121–126
(Contract NASw-1695)
(NASA-TT-F-12199) Avail: CFSTI CSCL 17B

The importance of electronics, radio, and computers in the solution of the many problems involved in the launching, propulsion and guidance of rocket boosters, calculation of trajectories and orbits of satellites, and collection, storage and transmission of data by devices aboard a satellite, is discussed in an article written prior to the first successful orbiting of an artificial earth satellite. Author

N69-22565# RAND Corp., Santa Monica, Calif.
SPECTRUM ENGINEERING SYSTEM PILOT PROJECT
A. L. Hiebert and S. A. Scharff Jan. 1969 33 p ref
(AD-682291; P-4006) Avail: CFSTI CSCL 17/2.1

The radio spectrum is sometimes looked upon as one of the nations natural resources. This is a fruitful viewpoint. Misuse of the resource is entirely possible; unbridled private exploitation is clearly not in the national interest; there is an increasing demand for access to the resource; and much has been discovered through exploratory research and development--and there is much more to learn--about the nature and uses of the resource. There are two unique properties of the spectrum, as a resource. It cannot be staked out on the ground; ownership cannot be established in terms of land rights. The spectrums second unique property is that it is not consumed in use. In fact, it is wasted if not used. The nation has a complex structure of organizations in and out of government, of laws and customs, of administrative apparatus and concepts, and of technical capabilities through which management of the use of the spectrum resources is effected. Of recent years there has been a remarkably inventive and explosive expansion in ways and intensities of use of the radio spectrum. But there has been nothing like a corresponding advance in the management of the nations use of the spectrum. Author (TAB)

N69-22576# Advisory Group for Aerospace Research and Development, Paris (France).
SCATTER PROPAGATION OF RADIO WAVES, PART 1
Aug. 1968 343 p refs Partly in ENGLISH, partly in FRENCH and partly in GERMAN Presented at the 24th Symp. of the Electromagnetic Wave Propagation Comm. of the Avionics Panel of AGARD, Standefjord, Norway, 19–23 Aug. 1968
(AGARD-CP-37) Avail: CFSTI

Various aspects of scatter propagation of radio waves are reviewed. The importance of scatter propagation for communication purposes, as well as the use of scattered radio waves as diagnostic tools for studying the scattering media, are discussed. Topics deal with scatter from the ionospheric D-, E- and F-regions, with scatter from the troposphere, and with scatter from the earth's surface. For individual titles see N69-22577 to N69-22604.

N69-22577# Advisory Group for Aerospace Research and Development, Paris (France).
GROUND SCATTER IN REVIEW
Edgar C. Hayden *In Its* Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 26 p refs
Avail: CFSTI

The possibility of HF radio wave transmission by scatter processes apparently was suspected as early as 1926. In the late 1920s and the 1930s the scattering of signals into the skip zone, in fact directly back to the point of emission, was noted frequently. During the 1940s and the first half of the 1950s, the surface of

the earth was convincingly identified as the scattering agent responsible for one major form of scatter transmission, that now called ground backscatter. Several applications which exploit ground scatter have been at least partially developed, e.g., current estimation of the primary coverage of an HF broadcast transmitter, methods for real-time choice of operating frequency in the HF band, studies of the structure of the ionosphere, and communication at frequencies above those normally usable. Author

N69-22579# Paris Univ. (France). Lab. de Physique de l'Exosphere.

ANALYSIS OF BACKSCATTERING PHENOMENA IN A BISTATIC EXPERIMENT USING TWO MONOSTATIC DECAMETRIC RADAR STATIONS [ANALYSE DES PHENOMENES DE DIFFUSION LATERALE DANS UNE EXPERIENCE BISTATIQUE A L'AIDE DE DEUX RADARS MONOSTATIQUES DECAMETRIQUES]

M. Crochet. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 11 p refs In FRENCH
Avail: CFSTI

A bistatic experiment between Valensole, France and Guadeloupe, Antilles analyzed scatter propagation by retroreflective soundings. The diffusion zones were determined using signal delay and different types of radar propagation were analyzed. The backscattering coefficient across the sea, for elevations of about ten degrees, was found to be about 22 dB and independent of azimuth. Transl. by B.P.

N69-22581# Paris Univ. (France). Lab. de Physique de l'Exosphere.

DECAMETRIC WAVE REFLECTION BY EARTH'S SURFACE AND ITS ROLE IN THE INTERPRETATION OF ECHO FREQUENCY SPECTRA OBTAINED FROM RETROREFLECTIVE SOUNDINGS [LA REFLEXION EN ONDES DECAMETRIQUES PAR LA SURFACE TERRESTRE EN EMISSION IMPULSIONNELLE ET SON ROLE DANS L'INTERPRETATION DES SPECTRES DE FREQUENCE DES ECHOS OBTENUS DANS EES SONDAGES PAR RETRODIFFUSION]

Claude Goutelard. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 22 p refs in FRENCH
Avail: CFSTI

The land surface and the sea are represented by mathematical models with a periodic component for the swell in the latter, to study decametric wave reflections induced by surface effects. In pulsed emission, three phenomena simultaneously appeared: diffusion, diffraction, and interference. For the case of reflection from the sea, a large part of the energy is transmitted in directions which give rise to propagations outside the large path. For the land case, diffusion produced a weakening in energy transmission in the direction of optical reflection. These theoretical results were used to explain the observed systematic differences in multiband ionospheric propagations where successive reflections all take place on the land or the sea. For diffusion in the incidence direction, the quasi-isotrope of diffused radiation can interpret the formation of echoes from retroreflective soundings by the interference of many different energy paths. A graphic method of deducing the spectral components of Doppler and fading data is presented using actual profiles and connecting their variations with those from ionospheric parameters. Transl. by B.P.

N69-22582# Government Communications HQ, Cheltenham (England).

HF GROUND BACKSCATTER ANALYSIS WITH THE AID OF COMPUTER RAY TRACING

R. G. Maliphant. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 18 p refs
Avail: CFSTI

A computer program is described which fits any electron density distribution with the minimum number of line segments required to meet a specified tolerance while preserving continuity of slope throughout the height range of the profile. The equation for the line segments is such that analytic expressions may be obtained for the various propagation parameters required in a ray-tracing program. The high speed with which ray paths may be calculated by the use of this technique permits stepped frequency backscatter records to be synthesised and plotted directly on the computer output form. A description is given of some of these plots and the general features are discussed. The possibility of reversing the process is then considered and the final section is devoted to a discussion of the problems involved in translating experimental backscatter records into synthetic oblique incidence ionograms for particular paths. Author

N69-22584# Defence Research Telecommunications Establishment, Ottawa (Ontario). Radio Physics Lab.

SOME CHARACTERISTICS OF GROUND SIDE-SCATTER AT 20 MHz

D. W. Rice. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 10 p refs
Avail: CFSTI

Observations were made at Ottawa of the time delay, horizontal angle of arrival, and amplitude of 20 MHz WWV time standard transmissions from Washington. These observations are interpreted in terms of two-hop propagation over a non-great-circle path, with scatter occurring from the ground beyond the transmitter and receiver one-hop skip distances. Due to the relatively small transmitter-receiver separation (710 km), these skip focusing regions nearly coincide. The observed signals arrive over an azimuthal range of 270° or more, with transit times 10 to 20 milliseconds in excess of that expected for great-circle propagation (3 milliseconds). It is often observed that time delay dispersion adds additional cycles to the transmitted one second "ticks", which are 5 cycles of 1 kHz tone. It is shown that this extension in time of modulation is due to scattering from two or more areas simultaneously, rather than from one extended area. Author

N69-22585# Marconi Co., Ltd., Great Baddow (England). Research Labs.

FADING AMPLITUDE DUE TO INTERFERENCE FROM FORWARD SEA SCATTER

G. C. Rider. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 10 p refs
Avail: CFSTI

The energy from the sea surface is assumed to be composed of a coherent reflected ray and incoherent scattered energy having a Rayleigh amplitude distribution. This model of the propagation is discussed in terms of the experimental and theoretical work of Beard and others, and curves are presented displaying simply the calculation of probability of fade depth. Low level ground-to-air propagation tests are described on three frequencies, bracketing the UHF and SHF bands, and the fading amplitudes which were measured are shown to be in acceptable agreement with the model. Author

N69-22586# Birmingham Univ. (England). Dept. of Electronic and Electrical Engineering.
APERTURE SYNTHESIS IN IONOSPHERIC GROUND BACKSCATTER RADAR
E. D. R. Shearman and J. Clarke *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 8 p refs
Avail: CFSTI

Work on the synthetic aperture system is described. The proposal is to use two aerials only, one fixed and one moving along a track, to record the time-averaged product of the two received backscattered signals and then to synthesize by computation the range/azimuth display which could have been obtained with a filled broadside array the length of the track. The recording of time-averaged product as a function of range and aerial separation is made photographically in the form of density variation over a two-dimensional raster. After processing, the photographic transparency is put in a multi-channel one dimensional optical Fourier transformer to yield the required range/azimuth map of ground targets. Results are given which have been obtained with an ultrasonic model using two separable transducers under water to detect targets illuminated by way of reflection at the rippled surface of the water. Author

N69-22591# Boeing Scientific Research Labs., Seattle, Wash.
PHASE QUADRATURE COMPONENTS OF THE MICROWAVE SCATTERED FIELD IN A SHORT TROPOSPHERIC PATH AS RELATED TO THE METEOROLOGICAL PARAMETERS
C. I. Beard, W. T. Kreiss, and W. G. Tank *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 10 p refs
Avail: CFSTI

A microwave propagation experiment was established on a line-of-sight path equipped with extensive meteorological instrumentation to show quantitatively the effect of the atmospheric scatterers on the microwave statistics. A particular microwave technique was used at 10.4 GHz which resolved the received microwave field into its phase quadrature components to provide the statistics of the incoherent scattered field *directly*, since these are the quantities sensitive to the atmospheric fluctuations. The effect of the sphericity of the wavefronts over the scatterers provided an additional descriptive parameter. The usefulness of the technique in scattering work was to pin down the statistical model of the scattered field. The meteorological instrumentation was unique in that integrated measurements were made of the defining refractivity parameters. Such integrated data allow direct comparison with the 10.4 GHz near field scattering effects. More conventional meteorological instrumentation was also utilized. Author

N69-22592# Stanford Univ., Calif. Electronics Labs.
PHASE AND AMPLITUDE MEASUREMENTS OF TRANSHORIZON MICROWAVES WITH A MULTI-DATA-GATHERING ANTENNA ARRAY
Donald C. Cox and Alan T. Waterman, Jr. *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 (See N69-22576 11-07) 16 p refs
Avail: CFSTI

A versatile vertical antenna array and receiving system, operating at 3.200 GHz, was utilized for the measurements. It consists of 12 parabolic antennas spaced 1.39 m apart on a tower, for a total vertical aperture of 15.24 m. The equipment samples phase difference between the elements and amplitude at each element at rates up to 100 passes per second over the 12 elements. Data were processed to produce a conventional array beam 0.3° wide, which was scanned in elevation to produce angular response patterns. Averaged angular response patterns, representing averages of about three minutes of data, were then compared with theoretical angular response patterns derived from a scattering model. The experimental patterns were divided into three groups. Group 1 patterns resemble the response of the array to a point source. Group 2 patterns can be described by a model predicting a smooth decrease of scattered power, with scattering angle at a rate proportional to the inverse m^{th} power of the angle, where m is between 4 and 10. Group 3 patterns are characterized by broadened maxima or two or more maxima, whose signals can be explained only by a model which contains a nonuniform scattering mechanism. Author

N69-22593# Research Inst. of National Defence, Stockholm (Sweden).
THE WAVELENGTH DEPENDENCE OF TROPOSPHERIC BEYOND-THE-HORIZON PROPAGATION
Folke Eklund *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 6 p refs (See N69-22576 11-07)
Avail: CFSTI

The wavelength dependence of actually received power in relation to free space power was measured over a 270 km tropospheric scatter path in middle Sweden. The frequencies were 1000 and 3000 MHz, and the antennas used were scaled according to the frequencies giving identical radiation diagrams with the beamwidth $\alpha = 2.2°$. The measurements were made during different periods within a year. The main findings were that the wavelength depence varies between λ^{-1} and λ^{+3}, and the exponent is correlated with the level of received power. In order to explain the results, it was necessary to consider the received power as the sum of two power terms: P_{SC}, power received from scattering by refractive index variations that are statistically homogeneous and isotropic; and P_R, power received from reflections by many small partially reflecting facets within the otherwise homogeneous and isotropic medium. The homogeneous and isotropic refractive index variations are characterized by their "power"-spectrum, which as a parameter contains the factor C^2_n, a measure of the intensity of the refractive index variations. The facets are characterized by the profile of refractive index through the reflecting surface, the radius of curvature of the surface, and the maximum tilt, with respect to the horizontal. Author

N69-22596# Federal German Post Office, Darmstadt (West Germany). Research Inst.
INVESTIGATION OF THE RECEIVING FIELD FOR SCATTER PROPAGATION
J. Grosskopf *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

Space and time correlation functions, as related to the structure of the electromagnetic field at the receiving site, were measured with a 418 km scatter link in the 2000 MHz frequency range using a three antenna arrangement. Analytical expressions for the correlation function and its scale length were derived. Author

N69-22599# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Dept. of Telecommunications
USING THE TROPOSPHERIC VOLUME OF A QUASI-BACKSCATTER LINK TO INVESTIGATE THE SCATTER MECHANISM
R. Menzel and Kh. Rosenbach *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 8 p refs (See N69-22576 11-07)
Avail: CFSTI

Investigations were made on a communications link with a vertically radiating antenna system in order to evaluate scattering

data with respect to a change in the scale of turbulence. The effect of diffraction paths between transmitter and receiver, and possibilities of accounting for these paths were considered. Experimental data obtained with the quasi backscatter link are also presented. Author

N69-22600# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Dept. of Information Processing.
NOTES ON THE THEORY OF TROPOSCATTER MODULATION DISTORTION
A. Wasiljeff *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 17 p refs Supported by Min. of Defence, Federal Rep. of Ger. (See N69-22576 11-07)
Avail: CFSTI

A generalization of a theory dealing with the distortion of FM modulation waves by a tropospheric scatter mechanism is given, including autocorrelation functions. The scattered field of modulated waves is described using a six-fold integral including the statistical parameters of the dielectric constant. The evaluation of this integral led to a convenient approximation: The field at the receiver may be considered as being made up of a small number of components which show unequal amplitudes and different delays with respect to the component arriving first. A physical interpretation of this mathematical approximation showed a main signal followed by one strong and several weak echoes, which was explained as a negative correlation between field strength received and intermodulation. The frequency multiplex signal was represented by a pre-emphased band limited Gaussian noise, and the intermodulation of such a signal caused by tropospheric effects was calculated. Author

N69-22603# Stanford Research Inst., Menlo Park, Calif.
THOMSON SCATTER AS A COMMUNICATION MODE
Allen M. Peterson *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

The application of Thomson scatter, the scattering of radio waves by density fluctuations of free electrons in the upper region of the ionosphere, to long distance communication in the VHF and UHF bands is discussed. As a result of previous studies using radar systems designed specifically for this purpose and analysis of theories on the subject, it was concluded that this technique would be useful for long distance communication. While high transmitter power and large antennas would be required, the communication capacity would decrease only slowly with distance for path lengths up to about 4000 km. A wide range of frequencies could be used, with the 100 to 1000 MHz range being the most likely for practical application. However, the Doppler spreading of the transmitted spectra which occurs with Thomson scatter precludes the use of conventional modulation and detection techniques. Instead, incoherent communications techniques involving frequency shift and/or pulse position modulated transmission and simple power observation in the receiving process would be necessary. Author

N69-22605# Advisory Group for Aerospace Research and Development, Paris (France).
SCATTER PROPAGATION OF RADIO WAVES, PART 2
Aug. 1968 277 p refs Presented at the 14th Symp. of the Electromagnetic Wave Propagation Committee of the Avionics Panel of AGARD, Sandefjord, Norway, 19–23 Aug. 1968
(AGARD-CP-37-Pt-2) Avail: CFSTI

The papers presented pertain to auroral scatter and VHF forward scatter, transequatorial propagation and F-region scatter, and F-region scatter. For individual titles, see N69-22606 through N69-22627.

N69-22610# Institute for Defense Analyses, Arlington, Va.
ELECTROMAGNETIC SCATTERING FROM A PLASMA SLAB HAVING LARGE SCALE, RANDOM ELECTRON DENSITY FLUCTUATIONS
Adolf R. Hochstim and Charles P. Martens *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 8 p refs Supported by ARPA (See N69-22605 11-07) (Proj. Defender)
Avail: CFSTI

Calculations are made of the energy reflected when a plane electromagnetic wave is incident normally upon a plane parallel plasma slab having random amplitude, step-function fluctuations of electron density. A statistical averaging method and the first-order Born approximation are used to obtain an expression for the component of the mean reflection coefficient due to random fluctuations. This expression is evaluated for exponential and uniform distributions of the step-function lengths in the case of an underdense, collisionless plasma having large scale fluctuations of electron density. The results are compared with those obtained using the first-order Born approximation, evaluated by means of the power spectrum of the fluctuations, and with the exact calculations from a computer model. It is shown that, for these cases when the correlation length is large (i.e., few correlation lengths in a slab), the first Born approximation using the power spectrum method deviates appreciably from an exact calculation. The statistical averaging method, or, equivalently, the use of the correlation function, gives improved results over the power spectrum method. Author

N69-22614# City Coll. of the City of New York.
STOCHASTIC THEORY OF THE SCATTERING OF ELECTROMAGNETIC WAVES FROM A RANDOM MEDIUM
C. M. Tchen *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 11 p refs (See N69-22614 11-07)
Avail: CFSTI

Wave propagation and scattering in a random medium is studied by means of a wave equation which includes the effect of a random plasma motion and the presence of a random density. The wave equation is derived from the coupled Maxwell equations and hydrodynamic equations. The second degree differential equation of wave propagation is transformed into a simple one-dimensional model equation which is solved exactly. The spectrum of the scattered power and the spectral functions of density and velocity are obtained. Author

N69-22622# Air Force Cambridge Research Labs., Bedford, Mass.
JOINT PROBABILITY DENSITY OF SIGNAL FADING AT SPACED RECEIVERS
T. J. Elkins *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 16 p refs (See N69-22605 11-07)
Avail: CFSTI

An attempt was made to apply the technique of spaced receiver measurements of fading signal propagation to include some cases in which the drifting screen analysis cannot be used successfully. One such case was the presence of one or more periodic fading components, which distort the cross-correlation functions between separate fading records. It was suggested that the joint probability density of the signal fading at pairs of receivers might provide useful information about the properties of the irregular medium. A model was considered of a one-dimensional sinusoidal phase screen, modulated by a random phase component, and the joint probability density of the field strength at two spaced points beyond the screen was derived. It was suggested that, in situations where the model is valid, several interesting parameters of the medium may be estimated by comparing experimentally measured fading distributions with the derived ones. An attempt was made at such a comparison, using data obtained from measurements of geo-stationary satellite transmissions. Author

N69-22778# Auburn Univ., Ala. Engineering Experiment Station.
CIRCULAR ANTENNA ARRAYS HAVING TANGENTIAL DIPOLES AS ELEMENTS, PART 2
C. H. Holmes and J. D. Tillman, Jr. Feb. 1968 133 p refs
(Contract AF 19(628)-4991)
(AD-681850; AFCRL-68-0271; SR-1) Avail: CFSTI CSCL 9/5

The integral equations describing the current distribution along the elements of a circular array of tangential dipoles are formulated, and it is shown that the leading term of a series solution is the usual sinusoidal approximation. This approximate distribution is used to calculate the terminal sequence impedance and far-zone radiation patterns for arrays of half-wave dipoles. Patterns are also found for arrays of short dipoles. The effect of asymmetry in the interelement coupling is investigated, and it is shown that an odd component exists in the current distribution, but that is is negligible for half-wave dipoles. Author (TAB)

N69-22888# Weather Bureau, Silver Spring, Md. Equipment Development Lab.
VIDEO INTEGRATOR AND PROCESSOR
Kenneth H. Shreeve Feb. 1969 26 p refs
(WBTM-EDL-8) Avail: CFSTI

The design and operation of a weather radar intensity contouring device, called a video integrator and processor (VIP), are described. Performance data are given on effective resolution, contouring range, integrating amplitude accuracy, effective display lag, input and output amplifier characteristics, reliability, maintainability, operating environment, and power requirements. Errors associated with the VIP and the accuracy of the device are discussed. B.G.D.

N69-22912# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ARITHMETIC CORRECTING CODES IN A SYSTEM OF RESIDUE CLASSES
S. R. Fain Jul. 1968 36 p refs Transl. into ENGLISH from Vychislitelnyi Tsentr. Tiflis. Tr. (USSR), v. 7, no. 2, 1966 p 60-91
(AD-682171; FTD-HT-23-151-68) Avail: CFSTI CSCL 9/4

Let Qo = or < A < P, alpha sub 1, alpha sub 2..... alpha sub n be the minimal nonnegative modulus residues of A in accordance with primes p sub 1, p sub 2,... p sub n. Then, the expression A = (alpha sub 1, alpha sub 2..... alpha sub n) will be a representation of the number A in the residual class system (RCS). Arithmetic operations are performed in RCS digit-by-digitwise. RCS-representation of addition, multiplication, divison, and negative numbers is written. An RCS-evaluation of an integer polynomial is given. Conversion of numbers from a generalized positional system into RCS and vice versa is explained; this conversion can be performed on an RCS-type arithmetic unit. TAB

N69-22949*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
A REVIEW OF RADIOMETRIC MEASUREMENTS OF ATMOSPHERIC ATTENUATION AT WAVELENGTHS FROM 75 CENTIMETERS TO 2 MILLIMETERS
William I. Thompson, III and George G. Haroules Washington Apr. 1969 20 p refs
(NASA-TN-D-5087) Avail: CFSTI CSCL 17B

Published values of vertical attenuation resulting from radiometric measurements of absorption and emission of the Earth's atmosphere in the wavelength range from 75 cm (0.4 GHz) to 2 mm (150 GHz) are presented. The literature search included a review of several hundred publications. These data emphasize the need for further theoretical and experimental work in the calculation and measurement of attenuation in this portion of the spectrum. *Author

N69-22951*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
RADIOMETRIC TECHNIQUES APPLICABLE TO THE MEASUREMENT OF SOLAR ACTIVITY AND ATMOSPHERIC ATTENUATION AT MILLIMETER WAVELENGTHS
George G. Haroules Washington Apr. 1969 21 p refs
(NASA-TR-R-306) Avail: CFSTI CSCL 17B

The available dynamic range for measurements of this type is determined by the brightness temperature of the sun and the sky noise fluctuation level at the frequency of observation. During the period of measurement, it is assumed that the solar flux intensity is constant and that all apparent variations in solar intensity are associated with atmospheric effects. Similar radiometric measurement instruments are used for the determination of solar radiation characteristics at millimeter wavelengths. Useful data are limited to those periods when the weather conditions are relatively mild. Here, the assumption is made that all apparent variations in solar intensity are associated with the radiation characteristics of the sun itself. The most useful data concerning solar radiation characteristics are obtained under clear weather conditions; that concerning atmospheric attenuation is obtained under adverse weather conditions. Author

N69-22976# Atomic Power Development Associates, Inc., Detroit, Mich.
FEASIBILITY STUDIES FOR AN ACOUSTIC IMAGE CONVERSION SYSTEM
S. Barkhoudarian Jul. 1968 85 p refs
(Contract AT(11-1)-865)
(APDA-223) Avail: CFSTI

To demonstrate the feasibility of imaging with an acoustic conversion tube at high temperatures, as well as the feasibility of transceiving in the pulse-echo mode, pulse units including a transmitter, receiver, amplifier, and control circuit were designed and built. Tests were conducted in both water and silicone oil using 2-MHz, 2 inch diameter, X-cut, single quartz crystal transceivers of various electrode designs. The results proved that an acoustic conversion tube can image in a transceiving mode, and that the tube can image at temperatures at least as high as 425°F, which was the peripheral temperature limit of the experiment. Author (NSA)

N69-23079*# North Carolina State Univ., Raleigh.
STUDY OF RECTANGULAR-GUIDE-LIKE STRUCTURES FOR MILLIMETER WAVE TRANSMISSION Progress Report
Frederick J. Tischer 15 Feb. 1968 69 p refs
(Grant NGR-34-002-047)
(NASA-CR-100637) Avail: CFSTI CSCL 17B

Various topics of millimeter wave transmission by unconventional guidance principles were investigated. Measurements of the attenuation and Q values of waveguide sections with artificial dielectrics were carried out at 35 GHz to gain information for the design of a prototype model of an H-guide with metallic strip structure. Measured reflection and transmission coefficients of lossy thick-wire grids were compared with computed values to verify the validity of relationships. Wire grids made of brass and silver-plated wires were used. A new concept in fence-guide design is outlined which is based on the fact that the energy leakage through the grid depends on the ratio of the phase velocity of waves in the waveguide to that of waves radiated from the wire grid. The revised relationships and graphs of the attenuation of single-slot H-waveguides are presented. Wall loss attenuation and dielectric losses are shown in the graphs in terms of the dielectric slab thickness and plate separation in normalized form. A computer program for obtaining the graphs is included. K.W.

N69-23104# Weather Bureau, Salt Lake City, Utah. Western Region.
THE WSR-57 RADAR PROGRAM AT MISSOULA, MONTANA
R. Granger Oct. 1968 30 p refs
(PB-180292; WBTM-WR-34) Avail: CFSTI CSCL 17I

This report on the Missoula, Montana, radar program and summary of radar studies is intended to show the development of a year-round operational program adapted to the needs of local and regional users. This support includes: routine observation for aviation and special observations for river forecast centers and fire-weather interests. Author (USGRDR)

N69-23163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LOG-A-POSTERIORI PROBABILITY METRIC FOR USE IN SEQUENTIAL DECODING
T. V. Saliga Washington Apr. 1969 25 p refs
(851-51-75-01-51)
(NASA-TN-D-4930) Avail: CFSTI CSCL 17B

Convolutional encoding with sequential decoding is one of the best coded communications systems available for spacecraft telemetry. When implementing a sequential decoder, a decoding confidence measure based upon the received signal probabilities is used. The best known measure is the log-a-posteriori probability metric. Tabulations of the metric for various telemetry system parameters are given. Both a continuous and a quantized metric are treated for various symbol signal-to-noise ratios on a Gaussian channel. Quantized symbol metrics are tabulated for 2, 4, 8, and 16 levels, and it is shown that the quantized LAP metric is an approximation of the ideal continuous metric. Author

N69-23216# Joint Publications Research Service, Washington, D.C.
DETERMINATION OF THE SPATIAL AND FREQUENCY SEPARATION BETWEEN RADIO EQUIPMENT PRODUCING MUTUAL INTERFERENCE IN THE ULTRA-SHORT WAVE BAND
V. Pchelkin 3 Apr. 1969 23 p refs Transl. into ENGLISH from Radiotekhn. (Moscow), no. 1, 1969 p 1-11
(JPRS-47777) Avail: CFSTI

As a result of problems involving mutual interference of stations operating on overlapping frequency bands, an analytical discussion is presented on the conditions under which the interference has no practical effect on the passage of a useful signal to the receiver. Formulas are derived for the radiation and reception of the interference, and the initial data required for calculating the mutual interference are outlined. Parameters are derived for calculating the desirable spatial separation in the case of two identical carrier frequencies, as well as for different frequencies; and interference due to tropospheric scattering is analyzed. Finally, the application of frequency separation, when spatial separation becomes impractical, is treated. A.C.R.

N69-23219# Joint Publications Research Service, Washington, D.C.
ANTIRADAR CAMOUFLAGE TECHNIQUES
Yu. G. Stepanov 27 Mar. 1969 40 p refs Transl. into ENGLISH from the book "Protivo-Radiolokatsionnaya Maskirovka" Moscow, Soviet Radio Publishing House, 1968 p 44-84
(JPRS-47734) Avail: CFSTI

The general principle of low reflecting shapes is to fit a shape to the target under the effect of which the maximum reflected electromagnetic energy is deflected in the direction away from the radar receiver. If because of structural requirements, it is impossible to use low reflecting shapes on an object, antiradar shields are used. A shield is a conducting sheet which is installed inclined against the vertical wall of the camouflaged object. Radio absorbing materials are a prospective means of antiradar camouflaging military and industrial targets. The camouflaging effect of surrounding local objects consists in the formation of noise as a result of reflections of electromagnetic waves from the surface of the Earth or the sea and also from inhomogeneities in the atmosphere. J.A.M.

N69-23317*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR EFFECTS ON VHF COMMUNICATIONS BETWEEN A SYNCHRONOUS SATELLITE RELAY AND EARTH GROUND STATIONS
Sheldon Wishna and James R. Greaves (Allied Res. Associates, Inc., Concord, Mass.) Washington Apr. 1969 11 p
(NASA-TN-D-5100) Avail: CFSTI CSCL 17B

An investigation has been performed to correlate VHF interference, as reported by participating ground stations, with the occurrence of certain solar phenomena. The participating ground stations were taking part in the Weather Facsimile (WEFAX) experiment, which utilizes the Applications Technology Satellite (ATS)-1 to relay processed meteorological data from a central weather station to the ground stations. The VHF communication system, located on board the satellite, is an active frequency translator with an uplink receive frequency of 149.22 MHz and a downlink transmit frequency of 135.6 MHz. The data were transmitted to the satellite from the ATS ground station located at Mojave, California. The ATS-1 satellite is at an altitude of 19,300 nautical miles and is located over the equator at 151° West longitude. Approximately 50 ground stations located in an area extending from the east coast of the United States to Australia and Japan participated in the program. The analysis was conducted over an 8-month period beginning on January 2, 1967 and continuing through August of the same year. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-21956 Oregon State Univ., Corvallis.
DESIGN AND EVALUATION OF A GLASS DELAY LINE CONTENT-ADDRESSABLE MEMORY SYSTEM
Peter Turner Rux (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-11917

The high cost of content-addressed memories (CAM) can be reduced significantly by using a circulating memory system. With the circulating system, comparison logic is shared by many memory locations to allow a reduction in cost. Three data organizations are described and evaluated and one is chosen as the best for implementation when 20 MHz, 100 μsec glass delay lines are used. The complete design of a CAM system is described which has a 2048 × 35-bit capacity and is capable of searching the entire contents in 100 μsec. Search criteria include equality and magnitude conditions. Operations include storing, fetching, and a variety of tagging functions. The described CAM has been constructed and installed as an operating addition to a general-purpose serial computer, the NEBULA. The CAM system has been a powerful addition to the NEBULA and be a useful yet economical addition to any computer system. Dissert. Abstr.

N69-21981 Detroit Univ., Michigan.
DESIGN OF AN OSCILLOSCOPE PLUG-IN SPECIAL PURPOSE DIGITAL COMPUTER FOR AVERAGING TRANSIENT DATA
Gilbert David Beinhocker (Ph.D. Thesis) 1968 295 p
Avail: Univ. Microfilms: HC $13.30/Microfilm $3.80 Order No. 68-14904

The subject of the dissertation is the design of a digital computer whose specific purpose is to separate from the noise the signal of interest, though the noise may be many times larger in amplitude than the signal. This type of computer is known as an averaging computer. Classical electronic filtering techniques are precluded in those instances where the noise lies in the bandwidth of the signal of interest. This technique represents a major advancement in electronic resolution measurement techniques. A digital averaging computer is designed which will plug into the ubiquitous oscilloscope. The design incorporates a novel logical design scheme for affecting the averaging process and eliminates the requirement for its own cathode ray tube assembly with associated circuitry and independent power supply. The cost of fabrication of the computer is such that it may be commercially sold for a price not to exceed $3,000. Dissert. Abstr.

N69-21984 Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ON THE BEHAVIOR OF LEARNING AUTOMATA AND ITS APPLICATIONS
K. S. Fu and T. J. Li Aug 1968 90 p refs
(GRANT NSF GK-1970)
(PB-180802; TR-EE68-20) Avail: CFSTI CSCL 09B

The report is concerned with the behavior of a class of learning automata operating in random environment which basically is assumed to be discrete and stationary. Based on the strategies of two-armed bandit problems, two sequential learning models and having deterministic and stochastic transition rules, are proposed. Automata using those strategies have shown certain advantages over the linear-strategy models. They are easy to implement since no further calculation is necessary except counting. The optimality can only be achieved asymptotically if the memory capacity increases indefinitely; hence, the number of trials must be infinitely large as well. A sharper bound of iterated logarithm inequality is derived. The learning composite fuzzy automaton operating in a random environment has shown the desired property of asymptotic optimality.
Author (USGRDR)

N69-22055 Michigan Univ. Ann Arbor.
A FUNDAMENTAL STUDY OF PREDICTIVE DISPLAY SYSTEMS
John De Shon Warner (Ph.D. Thesis) 1968 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-13426

The predictive display technique and its advantages and limitations in manual control systems are investigated. The problem of performance measurement is studied. A discussion of several potential applications is provided to point out the possible advantages of a predictive display and those characteristics which might be important. An experimental investigation on the effects of the controlled element dynamics on performance with three display forms (exploratory prediction, on-line prediction, and no prediction) in a time vs. error format is reported. It is concluded that predictive displays are potentially useful whenever the information processing requirements are severe and required mental prediction time spans are not short, but that additional studies are needed comparing predictive displays to semi-automatic and fully manual systems.
Dissert. Abstr.

N69-22073 IIT Research Inst., Chicago, Ill.
ON-LINE ADAPTIVE COMPENSATION OF MANUAL CONTROL SYSTEMS
Robert Paul Lang (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-14914

The subject of this study is the compensation of manual control systems characterized by time-varying system dynamics. Only continuous, single dimensional systems having random inputs and compensatory displays are considered. The result of the study is an adaptive compensator designed to minimize the human operator's task in time-varying control systems. The compensator is unique in that the adjustment of its parameters is based solely upon the operator's control actions. Operation of the adaptive compensator depends upon the adaptive and optimal control properties of the human operator. More specifically, the compensation that the operator introduces into a control system, via his control response, has been shown by others to represent the optimum equalization needed to control the given system, providing the needed equalization does not exceed that which the operator can produce. Dissert. Abstr.

N69-22074 Denver Univ., Colo.
THE DESIGN OF OPTIMAL CONTROLLERS TO MINIMIZE A PERFORMANCE INDEX CONTAINING TRAJECTORY SENSITIVITY FUNCTIONS
Albert Johnson Bradt (Ph.D. Thesis) 1968 71 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-13792

The problem of reducing the sensitivity of optimal control systems to plant parameter variations by including sensitivity functions in the performance index is investigated. Three basic cases are considered. In the first case, the true optimal control problem is solved in which no constraint is imposed on the structure of the system. The control in this case is a function of the trajectory of the nominal plant rather than the actual plant, hence is open-loop. In the second case, a parameter optimization problem is solved in which the plant control is assumed to be a linear combination of plant states. The time-varying coefficients of the plant states constitute a control for the system, and the maximum principle is invoked to determine necessary conditions for an optimal control. Finally, a dynamic controller is assumed which generates an approximation to the closed-loop sensitivity functions. The plant control is then assumed to be a linear combination of the plant states and approximate sensitivity functions. Dissert. Abstr.

N69-22111 California Univ., Davis.
SPATIAL AUTOCORRELATOR FOR OPTICAL PATTERN CLASSIFICATION
Paul Arthur Lux (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-14600

A new type of optical pattern identifier has been constructed and analyzed. The unique features of the machine are the manner in which the sensors scan the pattern (similar to the human eye), the reliance on random pulses to obtain the autocorrelation, and the use of two types of data processing in cascade. It was found that when scanning is combined with a network to obtain the sampled autocorrelation, two benefits result. The first benefit is a reduction of errors in the system due to the sensors not being uniformly spaced. The second is the removal of the need to place the pattern in an exact position relative to the sensors. At the same time information about the relative spacing of two features of the input pattern is retained. Dissert. Abstr.

N69-22143 Illinois Univ., Urbana.
APPLICATION OF MATHEMATICAL PROGRAMMING IN THE DESIGN OF OPTIMAL CONTROL SYSTEMS
Daniel Tabak (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-122903

A general nonlinear, nonautonomous control system was considered, and a method of applying mathematical programming in the optimization of this system was formulated and its effectiveness evaluated. A general, nonlinear, integral and terminal performance index, subject to nonlinear equality and inequality constraints, is treated. Several problems involving computational use of mathematical programming methods were solved. In particular, the systems treated were: 1) A linear control system controlled at decrete time intervals. Constraints limiting the time intervals from below and suppressing the overshoot are posed. 2) The problem of optimal shutdown control of nuclear reactors under xenon poisoning, where the system is described by a set of nonlinear state equations. 3) A nonlinear discrete time system expressed by difference state equations. 4) Design of an optimal digital controller for a nonlinear sampled data system. 5) Optimization of continuous time systems with discrete time control, with application to optimal nuclear reactor fuel recycle. The potential application of mathematical programming in the synthesis of optimal stochastic and adaptive control systems is also discussed. Dissert. Abstr.

N69-22155*# Maryland Univ., College Park. Computer Science Center.
DESIGN AUTOMATION BY THE COMPUTER DESIGN LANGUAGE
Yaohen Chu Mar. 1969 53 p refs
(GRANT Nsg-398)
(NASA-CR-100566; TR-69-86) Avail: CFSTI CSCL 09B

A Computer Design Language (CDL) has been developed for facilitating design automation of digital computers. When the functional organization and sequential operation of a digital computer are conceived and specified by the CDL, this CDL description is called a *Macro design*. It describes precisely and concisely what the computer is expected to do functionally step by step. The macro design is translated into a *Micro design* which is a set of boolean equations. This translation is called boolean translation. The micro design describes interconnections of gates, flip-flops, switches and the like as is done in a conventional logic design. The CDL simulator can also simulate and check out the micro design. The set of boolean equations can be translated by a digital computer into logic diagrams which may then be implemented by modules of logic circuits and memories. Author

N69-22159 Rensselaer Polytechnic Inst., Troy, N.Y.
DECODING BINARY SEQUENTIAL CODES
Roy Stanley Czernikowski (Ph.D. Thesis) 1968 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-13510

This thesis concentrates on two aspects of decoding binary sequential codes over a binary symmetric channel. It first investigates a likelihood ratio decision scheme to decode the first digit of a sequential binary message. The decoder employs the Fano algorithm to search the tree of code words for a sequence $\overline{W}_n$ that closely resembles the received sequence $\overline{V}_n$. The decoder decodes the first information digit of $\overline{V}_n$ as the first information digit of $\overline{W}_n$ if the ratio of the probabilities of $\overline{W}_n$ being correct in the first digit averaged over all codes to $\overline{W}_n$ being incorrect exceeds a certain value. The decision time is thus a random variable. The second objective of this thesis is to obtain an upper bound to the distribution of static computation $\underline{C}$; that is, we are upper bounding the probability that $\underline{C}$ is greater than or equal to some C_n. This problem is undertaken by decomposing it into a conditional probability. Dissert. Abstr.

N69-22165 Duke Univ., Durham, N. C.
THE DESIGN AND ANALYSIS OF A CORRELATION DATA PROCESSING SYSTEM
William Edward Hammond, II (Ph.D. Thesis) 1967 399 p
Avail: Univ. Microfilms: HC $18.00/Microfilm $5.10 Order No. 68-11690

The overwhelming task of processing the increasingly vast amounts of data received daily from scientific satellites places a premium on high-speed data processing systems. The design, analysis, simulation and evaluation of one such system is presented. The data processing system, which is based on crosscorrelation techniques, is designed to decode primarily signals encoded in a special form of PCM called pulse-frequency-modulation (PFM) which are received and recorded on magnetic tape. A detailed theoretical analysis is presented of the correlation detection of PFM signals for both coherent and noncoherent detection. The effects of signal shape, frequency variation and synchronization are considered and the word error probabilities as functions of these parameters are derived. Dissert. Abstr.

N69-22188# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTEGRAL-TYPE MEMORY SYSTEM
V. I. Perekatov Mar. 1968 7 p Transl. into ENGLISH of Byul. Izobret (USSR), no. 189019, 16 Nov. 1965 p 1-3
(AD-681617; FTD-HT-23-182-68) Avail: CFSTI CSCL 9/2

An author certificate was issued for a memory system which contains a ferrite layer with a system of parallel digit write-in wires placed on it. Above this layer is located another ferrite layer with a system of parallel readout wires perpendicular to the write-in wires. A third ferrite layer is located above this layer. Forced recording conditions are obtained in this memory system by placing two ferrite layers between the above mentioned ones. These layers contain recording and output wires. The output wires and the working parts of every number wire are placed in parallel to and above digit write-in wires. TAB

N69-22401# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
CONCEPTION AND FABRICATION OF A REAL TIME AUTOMATIC CORRELATOR (MULTICORRELATOR) [ETUDE ET REALISATION D'UN CORRELATEUR AUTOMATIQUE (MULTICORRELATEUR) FONCTIONNANT EN TEMPS REEL]
Daniel Berthier (Ph.D. Thesis--Grenoble Univ., 30 Oct. 1967) Oct. 1968 67 p refs In FRENCH; ENGLISH summary
(CEA-R-3482) Avail: CFSTI

The purpose of this work is to elaborate a specific computer able to display the real time correlation function of two variables represented by two electrical signals. The various functions to be carried out are dealt with the best suited technology: delays from numerical method, hybrid multiplication, analog integration. This method proved very versatile so that it has been possible to modify the circuits using more components without changing the general conception of the whole system. In particular, the bandwidth, which was originally 125 KHz (1966) is now 1 MHz and will be 5 MHz, by January 1968. Many results can be obtained from the correlator such as determination of pulse responses of linear systems (1st and 2nd order filters, oscillating circuits), extraction of signals from noise, measurement of time and space correlation in a turbulent plasma and treatment of electrobiological signals. Author (ESRO)

N69-22454# Atomic Energy Commission Research Establishment, Riso (Denmark).
DESCRIPTION OF AEK PROGRAMME NO. 513, EXPOSUM
Peter Kirkegaard Oct. 1968 14 p refs
(RISO-M-812) Avail: CFSTI

A computer program, AEK P-513 EXPOSUM, is described. The problem solved is a fitting of the constants in a sum of exponentials to given table values. EXPOSUM is written in GIER-ALGOL 3.
Author (NSA)

N69-22515# Los Alamos Scientific Lab., N. Mex.
PREDICTABLE UNFOLDING IN THE TIME DOMAIN
E. K. Hodson 29 May 1968 48 p refs
(Contract W-7405-ENG-36)
(LA-3830) Avail: CFSTI

The inverse numerical process, unfolding, frequently produces divergent solutions, and nearly always seriously increases the noise present in the resulting tabular function. The influence of noise on the unfolding process is controlled predictably by the method described here, in which a modified (constrained) inverse of the system response function is folded with the data. To generate the constrained inverse we unfold a properly chosen filter with the system response function, g(t), modifying the latter by truncation of its early portion. When this modified inverse is convolved with the data to be unfolded, noise enhancement is minimal. CONFOLD is a computer program which determines the minimum required truncation of g(t) by iteration, and unfolds a Gaussian filter, producing a constrained inverse which is then folded with the data. The unfolded frequency response is computed by use of the Fourier integral. Author (NSA)

N69-22516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A STATISTICAL METHOD FOR DETERMINING ERRORS IN COMPUTING EQUIPMENT USING ANALOG COMPUTERS
Yu. V. Verkienko and G. A. Tikhonov Jun. 1968 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), v. 10, no. 4, 1967 p 73–76
(AD-682174; FTD-MT-24-195-68) Avail: CFSTI CSCL 9/2

A method is described by which computing equipment error distribution may be obtained by using the Monte-Carlo method applied to an analog computer. In addition to the computer proper, the following units are needed to perform this task automatically: a low frequency random noise generator or a random sequence generator, multiplication and storage units for random sequences, and units for computing random process characteristics. The method takes into account the fact that the analog computer errors are of the order of a few percent. The method is illustrated as applied to a potentiometric multiplier having several multiplication stages. The error due to any one stage is computed by selecting a function converter whose characteristic corresponds to the relative voltage transfer function error of a single stage, and by applying a random noise signal for a preset length of time. The output signal will then represent a random process corresponding to the error distribution of a single multiplier stage. The author presents results of 200 such processes using a 3-stage multiplier. The mathematical estimates of relative error and mean error deviation for this series of processes were 5.05 and 1.4% respectively, which compares favorably with exact theoretical calculations that predicted 5.179 and 1.514% for the same quantities. Author (TAB)

N69-22517# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN QUESTIONS OF THE CONSTRUCTION THEORY OF MULTIDIMENSIONAL MEMORY UNITS
M. Ya. Eingorin and T. N. Eingorina Jun. 1968 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Radiofizika (USSR), v. 9, no. 5, 1966 p 1020–1028
(AD-682173; FTD-MT-24-154-68) Avail: CFSTI CSCL 9/2

Consideration is given to the construction of memory units on ferrite cores or other similar elements with multiple coincidence of currents. Proof is given of the theorem of the greatest number of insertions for devices with assigned parameters. Questions of decoding and construction of a large volume memory unit with increased reliability are discussed. Author (TAB)

N69-22633# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC ELEMENTS OF COMPUTER TECHNOLOGY (SELECTED ARTICLES)
Ya. A. Khetagurov et al Aug. 1968 39 p refs Transl. into ENGLISH from Tr. Vses. Soveshch. Magnitn. Elementam Automat. Vychislitelnoi Tekhn. (10th) Kaunas (Moscow), 1966 p 107–114, 130–134, 146–152
(AD-681632; FTD-HT-23-93-68) Avail: CFSTI CSCL 9/2

Contents: One design variant of a magnetic thin-film memory with a planar substrate; Memory matrices using thin magnetic films; and A memory device version based on cylindrical magnetic films. TAB

N69-22642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE COMPUTATION OF PRODUCTION CAPACITY UTILIZING PUNCHCARD MACHINES (SELECTED PORTIONS)
A. P. Kogan et al Sep. 1968 15 p Transl. into ENGLISH from the book "Raschet Proizvodstvennoi Moshchnosti s Ispolzovaniem Schetno-Perforatsionnykh Mashin, Moscow, Statistika, 1966 p 3–9
(AD-681646; FTD-MT-24-294-68) Avail: CFSTI CSCL 5/1

This authors note and introduction to the book deals with the many advantages of centralized, machine-aided calculation of industrial plans. A comparison is made between time spent on manual and machine computation of the same data.
Author (TAB)

N69-22643# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
CORRELATING REMOTE SENSOR SIGNALS WITH GROUND-TRUTH INFORMATION
Walter G. Eppler and Roy D. Merrill Nov. 1968 70 p
(AD-681843; LMSC-6-79-68-8) Avail: Issuing Activity CSCL 15/7

The paper describes two computer-based methods for data handling and display which significantly simplify the task of correlating remote sensor signals with ground-truth information. These techniques have been applied successfully to microwave radiometer and infrared spectrometer flight-test data. Results indicate that the digital computer, with its associated storage and display capabilities, makes possible systematic and accurate analysis of remote sensor data at low cost. In one approach, the computer is used to determine and display the exact path of the sensor boresight over the ground scene. Using this display, an investigator can observe visually certain simple correlations between the sensor return and the ground scene. In the second approach, the analyst uses a special light-pen console to put ground-truth information (in graphical form) into the computer. Using techniques described here for storing, retrieving, and processing graphical data, the computer automatically converts the ground-truth information into a form where it can be correlated directly with the remote sensor signals.
Author (TAB)

N69-22757# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPARISON OF RIGID AND MICROPROGRAM PRINCIPLES OF ETSVM CONTROL

G. D. Smirnov, V. Ya. Pykhtin, and G. G. Veselovskii Jul. 1968 16 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 10, 1966 p 1045–1051
(AD-682182; FTD-MT-24-215-68) Avail: CFSTI CSCL 9/2

At the present time microprogramming is used mainly in special purpose computers, computers for solving scientific and technical problems and in large general purpose systems. It is still impossible to give any general recommendations about the applicability of rigid and microprogram methods of control; in every special case it is necessary to make a thorough analysis on the basis of comparison of cost and productivity of all possible variants of computer system construction (including a combination of rigid programming and microprogramming). It is necessary to expect that development of ultra-high-speed elements for electronic digital computers (film circuits, tunnel diodes, and so forth) will in the future stimulate the application of the principles of microprogramming. Author (TAB)

N69-22761# Stanford Research Inst., Menlo Park, Calif.
HIGH-INFORMATION-DENSITY STORAGE SURFACES
Quarterly Report, 1 Jul.–30 Sep. 1968
L. N. Heynick Dec. 1968 45 p ref
(Contract DA-28-043-AMC-01261(E))
(AD-681892; ECOM-01261-14; QR-14) Avail: CFSTI CSCL 9/2

This program is devoted to the preparation and investigation of novel electron-beam-addressable storage mosaics and the construction of an experimental, large-capacity, high-speed data-storage system based on the use of such mosaics. Current emphasis is on so-called micro-cap mosaics, the elements of which are discrete, submicron-size capacitors at the bases of regular arrays of closely spaced holes in molybdenum/alumina/molybdenum film sandwiches. The technique of using a fine-mesh screen as an array of electrostatic lenses for resist exposure has been extended to the formation of images having about 0.5-micrometer spots spaced on about 1-micrometer centers. However, a larger illumination cathode is needed for obtaining more uniform exposure. Selective etching of alumina films with molybdenum as the resist is performed with a directed beam of tantalum fluoride, formed by reacting lead fluoride with tantalum. Modifications to the molybdenum lens system are described, which have resulted in very stable performance of the system, and useful storage and readout results are now being obtained therefrom. Development of the high-speed readout circuitry required has been initiated. Progress on the computer-aided design of lens/deflector systems capable of scanning 100,000,000 elements per field for storage mosaic address is covered. Author (TAB)

N69-22764# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONG LASTING MEMORY DEVICE WITH METAL PERFORATION CARDS (DZP-MK)
R. Ya. Chernyak, Yu. G. Salkov, and V. M. Pavlykh May 1968 12 p Transl. into ENGLISH from Avtomatyka (Kiev), v. 12, no. 2, 1967 p 81–83
(AD-681592; FTD-HT-23-33-68) Avail: CFSTI CSCL 9/2

A permanent storage unit (DZP-MK) with metallic punched cards is proposed. The standard permalloy or aluminum card (0.1 mm thick) is used for information storage; this card has 80 columns, with a total capacity of 80 x 12 = 960 bits or 24 numbers of 40 bits each. The DZP-MK unit consists of separate storage cells with a single metallic punched card in each cell. The cells consist of two insulating plates such as micarta an interrogation plate and a readout plate. Each plate has 80 grooves, (corresponding to column locations) 1 mm deep and 1.2 mm wide, and also has 12 permalloy stripe (3.2 mm wide and 100 micrometers thick) along the horizontal lines. The interrogate and readout wires lie in the grooves. The punched card is placed between these plates, and each hole permits maximum electromagnetic coupling between the interrogation and readout wires resulting in generation of the ONE signal in the readout wire when a pulsed signal is applied to the interrogation wire. With this signal equal to 0.6 amp at a frequency of 1 MHz, the ONE readout signal of 18 mv and ZERO readout signal of 4 mv were obtained at a signal-to-noise ratio of 8. Four cells are combined in the storage section, and 11 such sections can store 1024 numbers of 40 bits each. Author (TAB)

N69-22772*# Georgia Inst. of Tech., Atlanta. School of Electrical Engineering.
SAMPLING ERRORS IN CLOSED LOOP HYBRID COMPUTER PROGRAMS
Joseph L. Hammond, Jr. 15 May 1968 35 p refs
(Contract NAS8-2473)
(NASA-CR-98388; GIT/EES-A588/T17; TN-17) Avail: CFSTI CSCL 09B

A vector differential equation for error determination due to sampling is developed using several approximations derived with Taylor series expansions. The equation is applicable to general hybrid programs with no restriction of the manner in which the computing operations are allocated between the analog and digital computers. The major restrictions necessary for the error equation to apply are outlined, and a full description of the error equation is presented. It is concluded that solution of the equation typically requires machine computation, but several properties of sampling error became apparent from the form of the equation. A.C.R.

N69-22779# Naval Personnel Research Activity, San Diego, Calif.
NORMAP PROGRAM DOCUMENTATION
John H. Wolfe Dec. 1968 91 p
(AD-682200; NPRA-SRM-69-12) Avail: CFSTI CSCL 12/1

The report describes the operation and use of Program NORMAP - a method of cluster analysis and unsupervised pattern recognition. The program takes the scores or measurements of as many as 1000 individuals or objects and groups them into different types under the assumption that each type has a multivariate normal distribution of the scores and that all the distributions have the same covariance matrix. Complete program listings and illustrative printouts for the Fisher Iris data are included. Author (TAB)

N69-22780# System Development Corp., Santa Monica, Calif.
TOWARD THE DEVELOPMENT OF COMPUTATIONAL AIDS FOR OBTAINING A FORMAL SEMANTIC DESCRIPTION OF ENGLISH
John Olney, Carter Revard, and Paul Ziff Oct. 1968 71 p refs
(Contract F19628-67-C-0004)
(AD-682300; SDC-SP-2766(001)00) Avail: CFSTI CSCL 5/7

Projected automatic and semi-automatic routines for processing transcripts of Websters Seventh New Collegiate Dictionary (W7) and The New Merriam-Webster Pocket Dictionary (MPD) are briefly described. Among the outputs of these routines will be an approximation to a set of semantic primitives for English, hierarchically ordered lists of semantic classifiers, and semantic fields. The results of a study of productive lexical processes (both affixally marked and affixally unmarked) are reported, and its relationship to recent work in generative grammar is noted. Studies of several aspects of W7 definitions are described, with particular emphasis given to defining formulas. All of these studies have had the dual objective of clarifying the criteria by which the outputs of the routines for processing the W7 and MPD transcripts should be judged as well as contributing to the development of the routines. Author (TAB)

N69-22798# European Atomic Energy Community, Brussels (Belgium). Center for Information and Documentation.
STATISTICAL ANALYSIS OF CONCEPT CO-ORDINATION DOCUMENTATION SYSTEMS
G. F. Romerio and A. Cricchio 1969 26 p refs
(EUR-4213-e) Avail: CFSTI

The basic principles for a statistical analysis of concept coordination documentation systems are outlined and developed starting from the representation matrix of the system. The concept of ideal log-normal system is introduced, where the distribution laws for the descriptors' assignment frequencies and for the documents' coordination levels are both log-normal with the same median. The statistical analysis of EURATOM/CID Nuclear Documentation System is then performed and its characteristic parameters measured. Finally, a study of the dynamics (i.e., the variation of the number of descriptors with the number of documents indexed) in a documentation system is carried out starting from a simple working hypothesis. Author

N69-22803# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
STATE OF THE ART SURVEY OF THE DATA DISPLAY FIELD
R. E. Mahan May 1968 69 p refs
(Contract AT(45-1)-1830)
(BNWL-725) Avail: CFSTI

A survey was undertaken in order to provide a comprehensive study of the data display field. The scope of the survey is limited to computer-generated displays capable of operating in real-time on a dynamic control system. The scope is further limited to visual displays that present information to the eye by means of visual cueing. Emphasis is placed on the current state-of-the-art and future expectations of the data display field. A tabulation of commercially available console displays and a comprehensive display bibliography are provided in an appendix. Author (NSA)

N69-22809# Illinois Univ., Urbana. Dept. of Computer Science.
ENUMERATION OF PSEUDO-SEPARABLE FUNCTIONS OF FIVE VARIABLES
Glenn W. Fagerlin (M.S. Thesis) 8 Aug. 1968 35 p refs
(PB-180724) Avail: CFSTI CSCL 09B

Linear separability of switching functions has been studied widely in recent years. Methods of determining if a given function is a separable function, and if so, determining its optimal structure have been developed. It has been shown that the percentage of switching functions of n variables which are separable becomes small as n increases. Three percent of all four variable functions are separable functions, while only 0.002% of all five variable functions are separable functions. Slivinsky generalized the concept of linear separability by defining pseudo-separability to obtain a large class of functions. It is the purpose of this paper to investigate the class of pseudo-separable functions of up to five variables. Author (USGRDR)

N69-22815# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WAYS OF OF INCREASING AUTOMATIC PROGRAMMING EFFICIENCY
L. N. Ivanenko Jul. 1968 29 p refs Transl. into ENGLISH from Algorithmicheskie Yazyki i Avtomatiz. Programmirovaniya (USSR), no. 1, 1966 p 80–89
(AD-682184; FTD-MT-24-226-68) Avail: CFSTI CSCL 9/2

The general problems concerning the efficiency of program automation are discussed. The author considers the development and incorporation of translators from the complete ALGOL language a less effective means of programming automation than programming from symbolic addresses and using autocodes. The efficiency of ALGOL utilization decreases because little attention is being paid to equipment used for programming automation (reference is to serial devices for input-output for serial computers). The institute of Cybernetics AN UkrSSR developed a perforating device for the preparation of ALGOL-type programs using an appropriate keyboard. The device uses the A alphabet consisting of 256 symbols which includes Russian, Latin, and partially Greek alphabets, certain ALGOL symbols, and mathematical signs. The punch card accepts 5 symbols per line and the keyboard has 180 keys. All the symbols are classified and distributed on the keyboard in groups with some consideration of utilization frequency. The unit printing the texts from punch cards uses 8-digit codes in an expanded A alphabet with the unfolding of word-symbols of the ALGOL language into their full length or up to four letters. Appendices describe the proposed keyboard and the technical data concerning the punching and printing devices. Author (TAB)

N69-22818# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAGNETIC PROPERTIES OF TWO-LAYERS FILMS
G. P. Zharikov and V. V. Zvyagintsev Jul. 1968 11 p refs Transl. into ENGLISH from Fiz.-Teknol. Vopr. Kibernetiki (USSR), no. 1, 1966 p 64–72
(AD-682183; FTD-MT-24-217-68) Avail: CFSTI CSCL 9/2

The paper studies the feasibility of increasing the coercive forces in magnetic thin-film storages by depositing directly on the main film a second highly coercive layer. The magnetic films were made by vapor deposition of the alloys NiFe and CoFe. The bearing substance was glass. The results of the investigation are that the magnetic properties of thin two-layer films in direct contact average out because of the exchange connection between the magnetizations of the layers. TAB

N69-22832# Arizona Univ., Tucson. Dept. of Engineering.
DIGITAL COMPUTER INTERFACE SYSTEMS, HYBRID COMPUTER DESIGN AND SOME APPLICATIONS
[1968] 70 p refs
(EES-SR-22) Avail: Issuing Activity

CONTENTS:

1. DIGITAL-COMPUTER INTERFACE SYSTEMS G. A. Korn p 2–15 refs (See N69-22833 11-08)

2. A NEW SOLID STATE ELECTRONIC ITERATIVE DIFFERENTIAL ANALYZER MAKING MAXIMUM USE OF INTEGRATED CIRCUITS B. K. Conant p 16–33 refs (See N69-22834 11-08)

3. A NEW HIGH PERFORMANCE COMPUTER d-c AMPLIFIER J. R. Naylor p 34–40 refs (See N69-22835 11-08)

4. ECONOMICAL A-D CONVERSION FOR HYBRID COMPUTERS J. R. Goltz p 41–43 refs (See N69-22836 11-08)

5. A COMPARATORLESS DUAL-SLOPE DIGITAL VOLTMETER L. L. Schick (Burr-Brown Res. Corp.) p 44–50 refs (See N69-22837 11-08)

6. ANALOG/HYBRID COMPUTERS WITHOUT INTERCONNECTION WIRING G. A. Korn p 51–52 refs (See N69-22838 11-08)

7. ANALOG/HYBRID COMPUTERS IN ENGINEERING EDUCATION G. A. Korn p 54–61 refs (See N69-22839 11-08)

8. RELAY OPERATED MEMORY-PAIR R. J. Pillmer and J. H. Dial p 62–65 refs (See N69-22840 11-08)

9. OPTIMIZATION BY PARAMETER-PERTURBATION CORRELATION R. Gonzalez and M. Muterspaugh p 66–69 refs (See N69-22841 11-08)

N69-22833*# Arizona Univ., Tucson.
DIGITAL COMPUTER INTERFACE SYSTEMS
Granino A. Korn *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 2–15 refs
Presented at the AICA meeting, Versailles, France (See N69-22832 11-08)
(Grant NGR-03-002-024)
Avail: Issuing Activity CSCL 09B

This tutorial report reviews the important techniques for transferring data and control signals between digital computers and the outside world, and discusses, in turn, device selection and control for a party line I/O bus, device control, sensing, interrupts, and automatic data channels with direct memory access. Interfaces for iterative analog computers, for combined simulation, and for simple graphic displays are described as examples. Finally, special interfaces for random-process measurements and interfaces employing an intermediate digital processor are discussed. Author

N69-22834*# Arizona Univ., Tucson.
A NEW SOLID STATE ELECTRONIC ITERATIVE DIFFERENTIAL ANALYZER MAKING MAXIMUM USE OF INTEGRATED CIRCUITS
Brian K. Conant *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 16–33 refs (See N69-22832 11-08)
(Grant NGR-03-002-024) CSCL 09B
Avail: Issuing Activity

The Locust system comprises 34 free amplifiers of which 18 can be used as integrator/track hold circuits, plus 18 amplifiers permanently committed to six high-speed multiplier/dividers, and 4 comparators. The machine is capable of solving a sixteenth-order linear or nonlinear differential equation system up to 2000 times per second for iterative and random process computations under digital control. Linear errors are within 0.2 percent up to 10 kHz. Special slow summing networks also permit operation as a slow analog computer. The design includes new mounting and shielding techniques, including a method for shielding low cost unshielded patchbays. Maximum use of both linear and digital monolithic integrated circuits enhances computer performance while simultaneously reducing parts and assembly costs. Low level current-mode digital logic modules eliminate digital noise in the analog portion. The low-level logic swing, along with the balanced current nature of the nonsaturating current mode logic, serve to reduce radiation and computer ground system disturbances. Important features of the design are described, including the analog and digital elements, the digital-to-analog switch and logic-controlled relay, analog-to-digital converters, and locust/PDP-9 interface hardware. Author

N69-22835# Arizona Univ., Tucson.
A NEW HIGH PERFORMANCE COMPUTER d-c AMPLIFIER
Jimmy Ray Naylor *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 34–40 refs (See N69-22832 11-08)
Avail: Issuing Activity

A new computer d-c amplifier designed for very fast as well as for real-time analog/hybrid computation combines large bandwidth and high mid-band gain with full ±10V, 30mA output to 5.0 MHz, and low openloop output impedance. High d-gain and exceptionally low drift is obtained with the aid of an inexpensive hot-substrate integrated circuit preamplifier rather than with conventional chopper stabilization. A three-channel feedforward design employs an overcurrent-protected 30 mA class AB wideband output stage in the high frequency channel, a feedback-equalized integrated circuit operational amplifier as the intermediate frequency channel, and the hot-substrate integrated differential amplifier stage as the low frequency channel. Overcurrent protection makes the new amplifier short-circuit proof. Author

N69-22836# Arizona Univ., Tucson.
ECONOMIC AD CONVERSION FOR HYBRID COMPUTERS
J. R. Goltz *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 41–43 refs
Submitted for publication (See N69-22832 11-08)
Avail: Issuing Activity

The conversion system employs a separate ramp/comparator converter for each channel. Each converter utilizes an existing analog integrator both as a sample-hold circuit and as a precision ramp generator. The channel consists only of an integrated-circuit comparator and an IC gated counter. Expense and errors inherent in these components, and in the multiplexer switches, are virtually eliminated. While each conversion takes 50–260 μsec, the time is effectively divided by the number of conversion channels, since multiplexing is no longer required. The absence of a separate multiplexer also simplifies digital-computer interface electronics and programming. Converter design, circuit details, and performance evaluations are discussed. Author

N69-22837# Burr-Brown Research Corp., Tucson, Ariz.
A COMPARATORLESS DUAL-SLOPE DIGITAL VOLTMETER
Larry L. Schick *In* Ariz. Univ. Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [0968] p 44–50 refs
Submitted for publication (See N69-22832 11-08)
Avail: Issuing Activity

The design and operation of a digital voltmeter, employing a new technique in the analog-to-time converter, are discussed. The circuit is based on dual-slope integration, which eliminates the necessity of a highly stable clock. Any long term drift in the clock is canceled, so that a simple two-transistor multivibrator clock is used. With the aid of a special diode circuit, the ramp-generating integrator also serves as an accurate comparator, so that no separate comparator is needed for analog-to-digital conversion. The new circuit requires only a single up counter, and no special polarity switching circuits for automatic polarity indication are needed. The voltmeter has full-scale ranges of ±1 volt and ±10 volts. Tests on the instruments have shown its accuracy to be ±0.02 percent of half-scale. The sampling rate can be varied from 80 ms to 1 second, and the input impedance is 2 MΩ on the 10-volt range. Author

N69-22838*# Arizona Univ., Tucson.
ANALOG/HYBRID COMPUTERS WITHOUT INTERCONNECTION WIRING
Granino A. Korn *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 51–52 refs (See N69-22832 11-08)
(GRANTS NGR-03-002-024; NSF GY-379)
Avail: Issuing Activity CSCL 09B

The projected SUPERAPE computer design, involving combined analog-digital cards plugged across parts of both analog and digital patchbays, is presented. The design does away with all the previously required interconnecting wiring between analog and digital patchbays. The layout for small and medium sized analog/hybrid computers, appears to offer unusual promise for low cost, low maintenance design especially suited for modern integrated circuit logic and integrated circuit or epoxy cast amplifiers. Author

N69-22839*# Arizona Univ., Tucson.
ANALOG/HYBRID COMPUTERS IN ENGINEERING EDUCATION
Granino A. Korn *In its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 54–61 refs
Submitted for publication Sponsored in part by NASA (See N69-22832 11-08)

(GRANTS NSF GY-379; NSF GY-2468)
Avail: Issuing Activity CSCL 09B

The use of hybrid computation in universities is discussed, with emphasis on interest to engineering students. Undergraduate engineering department computer instruction at the University of Arizona is described. The APE 2 education computer system is valuable both for class demonstrations and student experiments. The graduate teaching/research program is discussed in terms of computer applications, small processor utility, and research emphasis. Graduate development programs are organized into pyramids of major projects, generally Ph.D. dissertation assignments, supported by three to six M.S. theses and groups of graduate and undergraduate term papers. P.A.B.

N69-22840# Arizona Univ., Tucson.
RELAY OPERATED MEMORY-PAIR
Rudolf J. Pillmeier and Joseph H. Dial *In Its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 62–65 refs (See N69-22832 11-08)
(GRANT NSF GY-379)
Avail: Issuing Activity

A relay-operated one-amplifier memory-pair circuit is described which frees a much more expensive track-hold pair of electronically switched integrators in sampled data system simulation. The circuit is intended for experiments with sampled data control systems and difference equations on inexpensive educational analog computers. The periodically operated relays can be driven by any laboratory oscillator if no logic circuits are available. Three typical experiments are described. Author

N69-22841*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
OPTIMIZATION BY PARAMETER-PERTURBATION CORRELATION
Robert Gonzalez and Milo Muterspaugh *In Its* Digital Computer Interface Systems, Hybrid Computer Design and Some Appl. [1968] p 66–69 refs Sponsored jointly by NSF, NASA, and USAF (See N69-22832 11-08)
Avail: Issuing Activity CSCL 09B

A simple method is described for steepest descent optimization of a criterion functional, determined by solutions of the system state equations. The system is simulated on a fast analog computer, and the design parameters are given mutually orthogonal sequences of binary perturbations during successive computer runs. Simple correlation of each parameter perturbation with the criterion functional value at the end of each computer run yields approximations for the gradient components needed for steepest descent optimization with a minimum of digital logic. As an example, two and three parameter model-matching problems are solved by iterative computation at 1000 iterations per second. Author

N69-22876# Oesterreichische Studiengesellschaft Fuer Atomenergie G.m.b.H., Siebersdorf. Reaktorzentrum.
FAST, HIGH-PRECISION ANALOG-TO-DIGITAL CONVERTER FOR IMPULSE SPECTROMETRY [SCHNELLER, HOCH PRAEZISER ANALOG-DIGITAL-KONVERTER FUER IMPULSSPEKTROMETRIE]
R. Petzelt 1968 71 p refs In GERMAN; ENGLISH Summary Submitted for publication
(SGAE-E-10/1968) Avail: CFSTI

An ADC with the following specifications was designed and constructed: 8192 channels, amplitude range 0.05 to 10 V, positive, conversion time 12 μsec max., integral linearity better than $\pm 2.5 \times 10^{-4}$, stability of channel-width 0.5%. In a modification of the linear capacitor discharge coarse and fine measurements are executed subsequently, combined of a fast discharge and an interpolation with a slow discharge. The address oscillator works at 20 MHz, the address register is advanced during the coarse measurement in steps of 64 channels and during the fine measurement channel by channel. The discharge current generators are switched in exact synchronism with the pulses of the address oscillator; a two-step synchronising circuit is used. Special circuits were developed for the pulse stretcher, the current generators, current switches, and the discriminator. The high degree of stability and linearity is achieved through the proper use of field effect transistors, linear integrated circuits, and fast digital integrated circuits. Author

N69-22924# Los Alamos Scientific Lab., N. Mex.
RDTRAN: A PROBLEM-ORIENTED LANGUAGE INPUT PROCESSOR
Emmett L. Brazier, Jr. and James H. Griffin 27 Nov. 1968 99 p refs
(Contract W-7405-ENG-36)
(LA-4020) Avail: CFSTI

The RDTRAN is a computer program for translating and processing free-format input data. It is an interpretive system designed for use as the input translator of a problem-oriented source language, or as a general purpose free-format input loader. RDTRAN is written in USA Standards Institute (USASI) FORTRAN for easy compatibility with a variety of computer systems, and also serves as an experiment in the effectiveness of USASI FORTRAN as a machine-independent language. A source language listing of the RDTRAN program is presented, and the IBM 7094 machine-dependent subroutines are included. Machine-dependent modifications for the CDC 6600 will be issued as a supplement. A reference guide, systems manual, and detail flowchart will be issued as companion reports. Author (NSA)

N69-22935*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
COMPUTER PROGRAM FOR DIMENSIONAL ANALYSIS
A. D. Sloan and W. W. Happ Washington Apr. 1969 31 p refs
(NASA-TN-D-5165) Avail: CFSTI CSCL 09B

In order to scale models of devices (ships, space capsules, integrated circuits, etc.) and phenomena (nuclear detonations, space-charge widening, sloshing in fuel tanks, etc.), it is necessary to determine nondimensional groupings of variables. A computer program establishes sets of invariant or nondimensional sets of variables and searches for an optimum set under specified optimization criteria. This Fortran IV program is based on algorithms of integer programming. Typical running times are 2 minutes for 10^4 sets of equations. Author

N69-22963# Rome Univ. (Italy)
ANALOG-DIGITAL CONVERTER FOR LABORATORY EXAMINATION [CONVERTITORE ANALOGICO-DIGITALE PER PROVE DI LABORATORIO]
E. Di Giacomo and F. Sebastiani 4 Jul. 1968 18 p in ITALIAN *Its* Note No. 175
(NP-17699) Avail: CFSTI

In the study of the characteristics of a wire spark chamber with magnetostrictive delay lines, it became necessary to construct a simple analog-to-digital converter for laboratory tests. The converter is described. It consists of a sinusoidal oscillator, former gate and converter gate, counting scale and readout device, reset, and overflow circuit. Each component is described. The characteristics and use of the converter are briefly discussed. Author (NSA)

N69-22977# Atomic Power Development Associates, Inc., Detroit, Mich.
ETOE: A PROGRAM FOR ENDF/B TO MC² DATA CONVERSION
D. M. Green and T. A. Pitterle Jun. 1968 50 p refs
(Contract AT(11-1)-865)
(APDA-219; ENDF-120) Avail: CFSTI

The computer program ETOE for preparing a MC^2 cross section library tape from a ENDF/B tape is described. The mathematical formulation is outlined, and flow charts and a sample problem are given. The program is written in FORTAN IV for the CDC 3600. (NSA)

N69-23082 Atomic Energy Commission Research Establishment, Riso (Denmark). Electronics Dept.
HYBRID OPTIMIZATION PROGRAM, QOG, FOR EAI 680 AND PDP 8
Soe Hojberg Aug. 1968 33 p ref
(RISO-M-790) Avail CFSTI

The program can optimize a multiparameter system set up on the analogue computer on the bases of a digital computed performance criterion. The parameter number is limited by hardware involved (<8 parameters for the present installation). The optimization method is the optimum gradient method with quantitized gradients. A 3 parameter program example for curve fitting is included. Author

N69-23106# National Bureau of Standards, Washington, D. C. Inst. For Basic Standards.
REFORM: A GENERAL PURPOSE PROGRAM FOR MANIPULATING FORMATTED DATA FILES
Robert C. McClenon and Joseph Hilsenrath Aug. 1968 30 p
(NBS-TN-444) Avail: SOD $0.40

A program listing and description is given of REFORM, an independent program with which it is possible to manipulate and edit files containing as many as nine different fixed field card formats. It can select or abridge information from any of the cards and print that information, or reformat new cards in any desired order or arrangement. Provision is made for introducing as many as twenty-six arbitrary strings of characters, each of which may be up to seventy-nine characters in length, thereby permitting the insertion of labels, headings or comments into the file. The program, which operates on the Univac 1108 computer, is written in ASA FORTRAN. Care has been taken to reduce to a minimum the program changes required to make the program run on other computers. Author

N69-23107# Advisory Group for Aerospace Research and Development, Paris (France). Naval Scientific and Technical Information Centre.
RESEARCH AND DEVELOPMENT IN THE HANDLING OF SCIENTIFIC AND TECHNICAL INFORMATION IN THE UNITED KINGDOM
A. H. Holloway 1968 42 p
(AGARD-AR-14) Avail: CFSTI

Notes are presented about a number of investigations and developments in the field, organized as to the facilities conducting each particular project. Some of the areas covered are library procedures, nuclear science abstracts production, information centers, indexing, document retrieval, instant libraries, and Wiswesser notation studies. P.A.B.

N69-23127# Stanford Linear Accelerator Center, Calif.
THE FORMAL DESCRIPTION AND PARSING OF PICTURES
Alan C. Shaw Apr. 1968 216 p refs
(Contract AT(04-3)-515)
(SLAC-84) Avail: CFSTI

Development of a picture description language for analysis and generation of pictures by computer is presented. Topics discussed include a linguistic model for picture processing, the PDL picture description language, the formal description of several picture classes, picture parsing, primitive recognition, and spark chamber film analysis by the SPDL (simple picture description language) system. Author (NSA)

N69-23128# Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Reaktorzentrum.
FAST HIGH PRECISION ANALOG-TO-DIGITAL CONVERTER FOR PULSE SPECTROSCOPY
R. Patzelt [1968] 29 p refs Submitted for publication
(SGAE-E-13/1968) Avail: CFSTI

An ADC with the following specifications was designed and constructed: 8192 channels, amplitude range 0.05 to 10 V, positive, conversion time 12 μsec max. integral linearity better than $\pm 2.5 \times 10^{-4}$, stability of channel width 0.5 %. In a modification of the linear capacitor discharge a coarse and a fine measurement is executed, combined of a fast discharge and an interpolation with a slow discharge. The address oscillator works at 20 MHz, the address register is advanced during the coarse measurement in steps of 64 channels and during the fine measurement channel by channel. The discharge current generators are switched in exact synchronism with the pulses of the address oscillator; a two-step synchronizing circuit is used. Special circuits have been developed for the pulse strecher, the current generators, current switches, and the discriminator. The high degree of stability and linearity is achieved through the proper use of field effect transistors, linear integrated circuits, and fast digital integrated circuits. Author

N69-23203# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
EXPERIENCE WITH PIVOT SELECTION METHODS FOR THE GOMORY ALL-INTEGER PROGRAMMING ALGORITHM
J. R. Cooper 16 Dec. 1968 16 p refs
(Contract W-7405-ENG-26)
(CTC-6) Avail: CFSTI

The results of a study involving pivot selection methods are reported. The study involves testing 19 proposed problems with 7 pivot selection methods. The objects of the study are to identify the method that is the fastest and most reliable on the particular problem set, and to identify the attributes of the problems that make them readily solvable by a particular method. Author (NSA)

N69-23322# National Bureau of Standards, Washington, D. C.
A FORTRAN PROGRAM FOR ANALYSIS OF ELLIPSOMETER MEASUREMENTS
Frank L. McCrackin Apr. 1969 84 p refs
(NBS-TN-479) Avail: SOD $0.75

A general Fortran program is given that performs the calculations required to analyze ellipsometer measurements. This program replaces a prior Fortran program. The main changes from the previous program are: 1) the new program is in Fortran 4 and 5 rather than Fortran 2; 2) the relative transmission of the wave plate is considered in analyzing ellipsometer readings; 3) an improved method is used for calculating the refractive index of a film; 4) the form of the input data is improved; 5) a method for calculating and correcting for tilt of the reflecting surface is given; 6) an improved method of calculating confidence limits for the calculated values of thickness and refractive index of a film is used; and 7) a method for calculating the optical constants of an absorbing film of given thickness is included. Author

N69-23337# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
THE SPRINT/1 LANGUAGE FOR THE DYNAMIC EVALUATION OF MATHEMATICAL FORMULAS BY DIRECT COMMUNICATION WITH A COMPUTER [LE LANGAGE SPRINT/1 POUR L'EVALUATION DYNAMIQUE DES FORMULES MATHEMATIQUES PAR DIALOGUE DIRECT AVEC UN ORDINATEUR]
Izvoras Cristian Cavadia (Ph.D. Thesis—Paris Univ.) Sep. 1968 368 p In FRENCH; ENGLISH summary
(CEA-R-3596) Avail: CFSTI

The Sprint/1 system is intended for real-time use of present day computers and can be used by persons without special preparation in the programming field. All input operations (instructions, comments, data) and corresponding output operations (printing of results and diagnostics) are done by a typewriter. It assures a bidirectional communication between the user and his program during its execution, the user indicating to the computer each step that must be performed to resolve the problem. At the same time the machine immediately flags the detection of a syntax or semantic error which allows him to correct or to improve his program immediately. It should be emphasized that the language is an evolutive one. Each introduced instruction enriches the language, the user having the possibility to easily build complex structures from very simple expressions. Thus he can make a general study of the behavior of a dynamic learning process of the machine which constitutes one of the characteristics of artificial intelligence. Author (ESRO)

N69-23344# System Development Corp., Santa Monica, Calif.
A DEDUCTIVE QUESTION ANSWERER FOR NATURAL-LANGUAGE INFERENCE
Robert M. Schwarcz, John F. Burger, and Robert F. Simmons 15 Nov. 1968 53 p refs
(Contract F33615-67-C-1986)
(AD-681531; SP-3272) Avail: CFSTI CSCL 5/9

The paper describes and exemplifies in detail the question-answering aspects of the Protosynthex III prototype language processing system, which is written in LISP 1.5 and operates on the Q-32 time-sharing system. The systems data structures and their semantic organization, the deductive question-answering formalism of relational properties and complex-relation-forming operators, and the question-answering procedures which employ these features in their operation are all described and illustrated. Examples of the systems performance and of the limitations of its question-answering capability are presented and discussed. It is shown that the use of semantic information in deductive question answering greatly facilitates the process, and that a top-down procedure which works from question to answer enables effective use to be made of this information. It is concluded that the development of Protosynthex III into a practically useful system to work with large data bases is possible but will require changes in both the data structures and the algorithms used for question answering. Author (TAB)

N69-23345# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MICROPROGRAMMED PNEUMATIC CONTROL DEVICE
G. V. Kreynin 30 Jul. 1968 18 p refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 3, 1967 p 10-17
(AD-682181; FTD-MT-24-214-68) Avail: CFSTI CSCL 9/2

The paper discusses the principle of construction of pneumatic systems of control of computer-automata. The approach is based on the use of a control device called an instruction apparatus. TAB

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-22013 Stanford Univ., Calif.
INDUCTORLESS FILTERS
Desmond Francis Sheahan (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-11348

Two distinct methods are described for making an integrated circuit which simulates the behavior of an LC (inductance-capacitance) filter structure. The first of these uses exactly the conventional LC filter structure and replaces each inductor by an integrable circuit that behaves like an inductor. The second method simulates the LC filter structure by making a complete model in the manner of an analog computer. It was found for both techniques, that, in order for the simulation to be successful, the original LC design should not have widely different LC ratios in its resonant circuits. The two techniques are compared from several points of view and the inductor simulation technique is found to have distinct practical advantage in that the filter capacitors isolate the bias circuits of the separate gyrators. The two techniques are completely integrable as they use only resistors, capacitors, transistors and diodes and both techniques clearly show that complex filters can now be built in integrable form. Dissert. Abstr.

N69-22016 Case Western Reserve Univ., Cleveland, Ohio.
NETWORKS WITH UNITY-GAIN VOLTAGE AMPLIFIERS
Dan Hilberman (Ph.D. Thesis) 1967 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-10163

This paper considers multiterminal common-ground networks of resistors, capacitors, self-inductors, and unity-gain voltage amplifiers (UGAs). When the UGAs are grounded the network's admittance matrix must belong to a particular subclass of the rational matrices. A synthesis procedure is given for realizing any member of this subclass. When the UGAs are not grounded a different procedure realizes any rational matrix as either the admittance or the transfer matrix of an inductorless network. The resistor values used in this procedure are directly related to the coefficients of the matrix elements and the capacitors used can be made to have one common value. Dissert. Abstr.

N69-22018 California Univ., Berkeley.
TEMPERATURE SENSITIVITY OF INTEGRATED OSCILLATORS
Richard Fletcher Adams (Ph.D. Thesis) 1968 192 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-13881

The oscillation frequency of a conventional RC oscillator realized as a monolithic integrated circuit is very temperature sensitive. The effects that contribute to this sensitivity are changes with temperature of (1) the passive frequency determining elements, (2) the amplifier gain level, and (3) the amplifier nonlinearity. A detailed analysis of each of these contributions is provided. A prediction of actual oscillator performance is made and is shown to agree well with the experimental results. Several methods to provide temperature compensation of monolithic integrated oscillators are determined from this analysis and the experimental results for uncompensated oscillators. The compensation techniques involve both linear and nonlinear effects. A theoretical analysis indicates that the compensation technique selected can provide a zero of temperature sensitivity of oscillation frequency at a specified temperature and a reduction by a factor of five over the uncompensated oscillators of the total frequency deviation for the temperature range considered. Dissert. Abstr.

N69-22029 Stanford Univ., Calif.
COMPUTER SYNTHESIS OF WIDE-BAND IMPEDANCE-MATCHING NETWORKS
William Thomas Hatley, Jr. (Ph.D. Thesis) 1968 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-11305

This report deals with an experimental investigation of the use of a digital computer to synthesize impedance-matching networks for arbitrary load immittances. The load immittance is described only in terms of measured immittance data, and not by a model (network). The computer algorithm developed will select the correct form of the matching network, as well as the element values, for an impedance match which is close to the optimum for the specified number of elements in the matching network. The problem is formulated for solution by digital computer as a multidimensional minimization problem. The most suitable objective function for the minimization process to operate upon is investigated. Along with a discussion of several known minimization techniques applicable to the problem, a new technique is developed which performs better than previously available methods on some problems. Dissert. Abstr.

N69-22148*# Techtran Corp., Glen Burnie, Md.
DIFFUSION-TYPE SILICON CONTROLLED RECTIFIERS
Takashi Nakagawa Washington NASA Apr. 1969 16 p refs Transl. into ENGLISH from Toshiba Rev., Intern. Ed. (Tokyo), v. 16, 1961 p 1358–1362
(Contract NASw-1965)
(NASA-TT-F-12141) Avail: CFSTI CSCL 09A

A new type of silicon controlled rectifier (SCR) with an output of 200 amperes, 400 volts was developed by the double diffusion process. An analytical calculation is made of the forward characteristics of the SCR element in the conduction state which gives basis for the design of the new rectifier. Gallium as a P-type impurity is first diffused on both faces of an n-type silicon substrate, and then phosphorous, as an n-type impurity, is diffused on one face, thus forming a p–n–p–n wafer. This wafer is then soldered on a copper electrode by means of direct soldering. Author

N69-22259# City Coll. Research Foundation, New York.
ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS Triannual Report Number 5, 1 Apr.–31 Jul. 1968
Morris Ettenberg Dec. 1968 42 p ref
(Contract DAAB07-67-C-0159)
(AD-682073; ECOM-0159-5) Avail: CFSTI CSCL 9/1

The first experimental tube with an endfire cathode failed due to an open heater. A redesigned cathode was tested in a vacuum bell jar and showed uneven heating. A further redesign produced a cathode which tested satisfactorily in the bell jar. A second experimental model incorporating the new cathode was processed extensively. However, the base overheated and the epoxy sealant leaked. The trajectory calculation program was completed, plotting ten electrons including space charge, and calculating and plotting the current in three collectors. Author (TAB)

N69-22304# Battelle-Northwest, Richland, Wash. Control and Instrumentation Dept.
THE EFFECT OF CO-60 IRRADIATION ON PASSIVATED AND NONPASSIVATED AVALANCHE DIODES BIASED NEAR BREAKDOWN
N. C. Holtink Dec. 1968 57 p refs
(Contract AT(45-1)-1830)
(BNWL-788) Avail: CFSTI

Irradiation of the same type of passivated and nonpassivated avalanche diodes was observed to produce significantly different effects. Irradiation in a 2×10^6 R/hr, ^{60}Co gamma field, with the diodes biased at 5% below breakdown permitted investigation of the effects on multiplication mode operation, a mode possibly suitable for application of diodes as radiation detectors. During the experiments, encapsulated diodes and those with the container removed but with vacuum applied received exposures up to 1.4×10^8 R. Comparison of performance in the gamma field indicated passivated diodes to possess superior operational characteristics, particularly for stability and predictability of the reverse current, both with and without encapsulation. The nonpassivated devices evidenced continuous changes in reverse current, especially with the encapsulation removed. Author (NSA)

N69-22462# Naval Avionics Facility, Indianapolis, Ind.
HEAT TRANSFER STUDIES ON NAFI STANDARD HARDWARE PROGRAM MODULES Final Report
Harry E. Kirk Sep. 1968 91 p refs
(AD-681731; NAFI-TR-1225) Avail: CFSTI CSCL 09/5

The report contains techniques for calculating the heat transfer of a Standard Hardware module, designing a module with respect to heat transfer, test data from a specially constructed module, and comparison of test data with theoretical data. Author (TAB)

N69-22484# University Coll., London (England).
SENSITIVITIES AND STABILITY OF OPEN-STRUCTURE PHOTOMULTIPLIERS IN THE 1100 Å TO 250 Å REGION
Adrienne F. Timothy, J. G. Timothy, and A. P. Willmore *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 87–100 (See N69-22476 11-30)
Avail: CFSTI

The paper describes in some detail the performance of the Bendix M306 magnetic electron multiplier. The comparative performances of both the model M310 magnetic electron multiplier and two types of Mullard channel intensifier are also given. Absolute efficiencies as a function of wavelength are quoted, typical values for the M306 and M310 multipliers being 2.5 per cent at 1000 Å, 5.0 per cent at 600 Å and 2.0 per cent at 300 Å; and for the channel intensifiers, 3.0, 6.5 and 6.5 per cent respectively at these wavelengths. Fatigue effects in both the magnetic electron multiplier and the channel electron under high vacuum are also described, and the result of the fatiguing on the long-term stability of the photomultipliers for satellite use is discussed. Author (ESRO)

N69-22485# Tubingen Univ. (West Germany). Astronomical Inst.
THE PERFORMANCE OF OPEN-STRUCTURE PHOTOMULTIPLIERS IN THE SOFT X-RAY REGION
U. Mayer, M. Mozer, and M. von Reinhardt *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 101–110 refs (See N69-22476 11-30)
Avail: CFSTI

Two Bendix M316 magnetic electron multipliers and two Mullard channel intensifiers B400A and B2008 were operated in the wavelength range 1.5 to 44 Å. No dependence of the pulse height distribution on wavelength or pressure was found between $4 \cdot 10^{-5}$ and $5 \cdot 10^{-6}$ torr. For the Bendix multipliers it was also independent of the pulse rate up to 10^4 pulses/sec. The pulse height distribution of helically shaped channel multipliers showed a marked dependence on the count rate. Furthermore, the shape of the pulse height distribution curve is strongly dependent on the glancing angle. Investigations of the dependence of the Bendix multiplier gain on the applied voltage showed that, besides the well known optimum voltage difference, a voltage range exists where gain instability and multiplier fatigue occurs. This range is independent of output current up to 10^{-9} A. No other gain loss was observed during some hundred hours of operation. During high voltage

application the resistance and gain of the Mullard channel intensifiers decreased slowly and continuously against an asymptotic value. Only the pulse height, not the count rate is affected by this decrease. There was no other gain reduction or fatigue with time during several hundred hours of operation and no gain variations greater than 5 per cent. Author (ESRO)

N69-22850# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
A MULTIMODED CAVITY PROBE TO PROVIDE HIGH SPATIAL RESOLUTION OF WAKE TRAIL IONIZATION MEASUREMENT Final Report, Mar. 1967–Mar. 1968
D. Rosenberg Arnold Air Force Station, Tenn. AEDC Feb. 1969 84 p refs
(Contract F40600-67-C-0012)
(AD-682293; AEDC-TR-69-32) Avail: CFSTI CSCL 9/1

This report discusses properties and use of a highly resolving r.f. cavity probe system for wake trails in hypervelocity model ranges. Data are taken from two distinct modes of the system and yield electric susceptance at an average axial position inside the cavity. This is important in wake trail study, since it ties together a wake electrical measurement with distance behind a hypervelocity model. Author (TAB)

N69-22779*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ELECTRO-MECHANICAL dc VOLTAGE AMPLIFIER
Chester R. Savelle, Jr. (Spaco, Inc.) 26 Mar. 1969 29 p Prepared by Spaco, Inc.
(Contract NAS8-20081)
(NASA-TM-X-53803) Avail: CFSTI CSCL 09A

A description is presented of a dc voltage amplifier which utilizes the principles of an electro-mechanical servo system to achieve gain stability. A description of the system and equations for design and error analysis are included. Author

N69-22898# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Inst. fuer Hochspannungstechnik und Elektrische Anlagen.
DETERMINATION OF THE CURRENT AND VOLTAGE CHARACTERISTICS OF THE 1.2-MJ CAPACITOR BANK AT THE KFA, JUELICH
I. Christou 20 Dec. 1967 18 p In GERMAN
(BMwF-FBK-68-21) Avail: CFSTI

The determination of the current and voltage characteristics under various operating and disturbance conditions of the 1.2 MJ capacitor bank is described. At the outset, the equivalent circuit developed for the planned calculations is described. Measuring methods for the experimental determination of the elements of the equivalent circuit are then described. The calculated current and voltage characteristics on the loading-coil are included. The special case of a disturbance with the prefiring of a crowbar-gap is then dealt with. Numerical calculations have shown, among other things, that the overloading of individual circuit elements of the capacitor bank can be reduced in such a case with the help of a safety circuit. Author (NSA)

N69-22903#
INSULATED-GATE FIELD-EFFECT TRANSISTOR IN ELECTROMETER APPLICATIONS FOR HIGH-RANGE RADIACMETERS
[1968] 9 p Presented at Elec. and Electron. Measurement Test Instr. Conf., Ottawa, Ontario
(EEMTIC-67-2-2; Conf-670124-1) Avail: AEC Depository Libraries

Design and performance of an insulated-gate field-effect transistor for use as a battery-operated dc amplifier for high-range ionization chamber for gamma detection are presented. NSA

N69-22904# Sandia Corp., Albuquerque, N. Mex.
ACCEL GRAPHICS SYSTEM
D. L. Caskey Jul. 1968 26 p
(SC-TM-68-419) Avail: CFSTI

Some graphic intervention capability has been added to the ACCEL system. ACCEL is a computer program to lay out printed circuit boards and produce drawings for their construction. The input to ACCEL is encoded from an engineer's schematic by a clerk. ACCEL is written in Fortran II for the IBM 7090/7094 computer and the drawings are produced on the Stromberg Carlson SC-4020 cathode-ray tube plotter. The graphic additions allow the ACCEL-generated placement of components to be displayed on a PDP-7 graphic system, and necessary and/or desired changes to be made via light pen. ACCEL then continues as before to produce the routing and drawings. See SC-TM-65-544 for a discussion of ACCEL. Author (NSA)

N69-22914# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHF TRANSMISSION LINES AND ANTENNAS. NOMOGRAMS
V. M. Rodionov Mar. 1968 324 p refs Transl. into ENGLISH of Linii Peredachi i Antenny Sverkahvysokikh Chastot. Sb. Nomogramm. (Moscow), 1965 p 1–119
(AD-681830; FTD-HT-23-1383-67) Avail: CFSTI CSCL 9/1

The book contains 104 nomograms which cover the most frequently encountered problems in the design of transmission line elements and antenna devices for microwave frequencies. They facilitate computation and greatly reduce the time of repetitive calculations. In addition, the nomograms can solve several analytic and research problems encountered by scientific workers who do not engage in large scale calculations. The book consists of an explanation brochure and a set of nomograms. The brochure can be used as a handbook containing data on the character and range of application of the formulas on which the nomograms are based. TAB

N69-22929*# Auburn Univ., Ala. Dept. of Electrical Engineering.
A CLASS D dc AMPLIFIER WITH ISOLATED OUTPUT
M. A. Honnell 28 Feb. 1968 59 p refs
(Contract NAS8-11344)
(NASA-CR-98375) Avail: CFSTI CSCL 09E

The development and design are presented of a transformer-coupled output circuit for use with a class-D amplifier. With the transformer-coupled output circuit, both a–c and bipolar d–c output signals may be produced. The output circuit requires but a single d–c power source. The theory of class-D amplification is presented. The mode of operation of class-D amplifiers which have been previously developed is explained. The significant advantages and disadvantages of this type of amplifier are discussed. The theory describing the operation of the transformer-coupled output circuit is presented. The design equations for the output-circuit transformer are developed for the general case. Equations yielding the maximum values of certain circuit parameters are also developed to serve as criteria in component selection. An experimental transformer-coupled output circuit was designed and constructed. The circuit was operated with a pulse-width modulator and driver circuit to form a class-D amplifier. Author

N68-22983# Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Elektronik.

SUITABILITY OF CIRCUITS WITH NEGATIVE DIFFERENTIAL RESISTANCE CHARACTERISTICS AS FAST ELECTRONIC SWITCHES IN THE NANOSECOND RANGE [UEBER DIE EIGNUNG VON ANORDMUNGEN MIT NEGATIVER DIFFERENTIELLER WIDERSTANDCHARAKTERISTIK ALS SCHNELLE ELEKTRONISCHE SCHALTER IM NANONENSEKUNDEN BEREICH]

Wennemar A. Brocke Aug. 1968 141 p refs In GERMAN (JUL-549-ZE) Avail: CFSTI

The devices were studied as part of the development of a double-impulse generator for use in the polarographic High Level Faradaic Rectification method. This method is suitable for investigations of the kinetics of electrode processes and for determining the velocity of very fast chemical reactions in solution when coupled with an appropriate electrode process. A systematic search was conducted for electronic switches with a short cut-in time ($\leq 5 \div 10$ nsec), high rate of current transmission, and high switching potential. A general, definitive review of commercially available electronic switches was performed to characterize cut-in mechanisms, threshold behavior, and stability criteria. As a result of the review, four types of switches came into closer consideration: the rare-gas thyratron and the avalanche transistor for use in connection with a discharge cable; the thyristor when used with a process to increase the width of the transition interval; and the tunnel diode, considered only for use as an auxiliary switch because of its low switching potential. Detailed data of the cut-in behavior of these four switches were experimentally derived and are compared with the findings of other investigators. Two switch designs for single-impulse generators with avalanche transistors and rare-gas thyratrons are also presented. Transl. by K.W.

N69-22975*# Westinghouse Electric Corp., Pittsburgh, Pa.

RESEARCH AND DEVELOPMENT STUDY ON WIDE BAND-GAP SEMICONDUCTOR FILMS Interim Report, Jun. 1967–Nov. 1968

A. J. Noreika, M. H. Francombe, and S. A. Zeitman Dec. 1968 127 p refs

(Contract NAS12-568)

(NASA-CR-86138) Avail: CFSTI CSCL 09A

Thin films of AlSb, AlAs and AlP were prepared by a three-temperature reactive evaporation technique, while films of AlN were deposited using a reactive sputtering method. Reactive sputtering was also used to produce films of AlSb. The structural, optical, and electrical properties of these films were examined and related to conditions of deposition. The properties were compared with published data for these materials in (where available) thin film, or alternatively bulk, single-crystal form. Mobilities in the antimonide, arsenide, and phosphide were very low, which is attributed to the many grain boundaries inherent in films made up of small crystallites. The films of AlN were sputtered for the first time in residual ultra-high vacuum conditions. An anomalous shift to lower energies in the position of the optical absorption edge for as-deposited films could be removed by annealing in N_2. Films of a mixed AlN–Si_3N_4 composition were deposited by the diode reactive sputtering of an Al–Si cathode of variable composition. Boron nitride films were prepared by diode reactive sputtering and showed some dielectric properties comparable of superior to those of AlN. K.W.

N69-23103# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.

UNION CARBIDE AUTOMATIC ROUTING AND DESIGN SYSTEM (UCARDS) FOR PRINTED CIRCUIT BOARDS, USER'S MANUAL

J. F. Jamison 13 Dec. 1968 94 p

(Contract W-7405-ENG-26)

(K-1736-Rev) Avail: CFSTI

UCARDS is a computer aided design system for producing component layout, conductor layout, and other aids to the fabrication of printed circuit boards. This manual is intended to serve as a guide to the proper use of the system, and supersedes report K-1736. Author (NSA)

N69-23186# Centre d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).

PHYSICAL IDENTIFICATION OF TWO TERMINAL TRANSISTORS IN A STATIC REGIME AND AN ELABORATION OF THE CAO ASSOCIE PROGRAM [IDENTIFICATION PHYSIQUE DES TRANSISTORS BIPOLAIRES EN REGIME STATIQUE ET ELABORATION D'UN PROGRAMME DE CAO ASSOCIE]

G. Rey and M. Diaz [1968] 18 p refs In FRENCH

Avail: CFSTI

A representation of the behavior of transistors in a static regime is proposed. This scheme is derived by considering the two dimensional nature of the conduction phenomena in the active zone of the base, the influence of surface phenomena on the conduction of the junction emitter-base, and the presence of the lateral zone of the collector. The model offered the advantage of taking into account only independent parameters of polarization conditions which can then be studied separately. The CAO program is considered briefly; it is involved with testing different types of equivalent schemes. The method used for the establishment of a system of differential equations to govern the functioning of the circuit and the methods used for the integration of this system are also indicated. Transl. by B.P.

N69-23204*# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.

SATURN INTEGRATED CIRCUIT RELIABILITY TEST PROGRAM Final Report, 28 Jun. 1966–1 Jul. 1967

K. R. McKenzie and M. R. Carpenter Jul. 1967 239 p refs

(Contract NAS8-18018)

(NASA-CR-98378) Avail: CFSTI CSCL 09A

The reliability was studied of two classifications of linear integrated circuits made by different manufacturing processes. Eight hundred test samples were selected. These samples were equally divided between the MC-1530F operational amplifier, the MC-1525G differential amplifier, the MC-1519G differential amplifier, and the SN-526 operational-differential amplifier. The results are summarized of the program to design or evaluate screening tests and estimate their effectiveness, to develop or define methods for linear circuit reliability analysis and stress evaluation, to develop a method for predicting early failures, to estimate the life expectancy of these circuits, and to consider stresses associated with handling, testing, and installation in equipment. A survey of existing reliability physics literature and semiconductor test reports was conducted to support the design phase of the test program. At the conclusion of this data search, the failure mechanisms were categorized with respect to the region or area of the complete integrated circuit affected, e.g., bonds, interconnects, passivation, surface contamination, bulk defects, and other miscellaneous failure mechanisms. The testing techniques emphasized operating, storage life, and step-stress testing. B.P.

N69-23220*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SIMPLE METHOD FOR MEASURING THE ATTENUATION CONSTANT OF WAVEGUIDES
Eduard Klausmann 1968 15 p Transl. into ENGLISH from Frequenz (France), v. 22, no. 7, 1968 p 188–192
(Contract NAS7-100)
(NASA-CR-100603) Avail: CFSTI CSCL 09A

The problem of investigating the usability of silver conductive lacquers in the microwave region has arisen. The characteristic magnitude by which such a preparation should be judged is, from the physical point of view, the specific conductivity. In practical application, it is the losses of structural elements treated with these lacquers that is of interest. In addition to the geometry of the structural elements and the specific conductivity, the surface condition of the lacquers is largely responsible for the losses because of the slight skin thickness at high frequencies. It, therefore, appears appropriate for a practical comparison not to use the conductivity of the lacquers but rather the losses of a simple microwave structural element, e.g., the losses of a rectangular waveguide whose inside walls are painted with conductive lacquer to be tested. Author

N69-23225*# Texas Instruments Inc., Dallas.
RELIABILITY HANDBOOK FOR SILICON MONOLITHIC MICROCIRCUITS. VOLUME 1: APPLICATION OF MONOLITHIC MICROCIRCUITS
William C. Weger et al Washington NASA Apr. 1969 235 p refs
(Contract NAS8-20639)
(NASA-CR-1346; Rept-03-67-04-Vol-1) Avail: CFSTI CSCL 09A

Described are: (1) typical problems that were experienced with certain applications and modes of operation for several families of digital and linear microcircuits; (2) the most reliable and trouble free methods of use or application of each type of circuit presented; (3) how to obtain maximum information from manufacturers' data sheets; (4) a method for derating the devices in actual use, and a method by which to assess the gain (or loss) in circuit performance and reliability which results from the application of the derating method; (5) the characteristics, advantages, and disadvantages of the various types of packages now available, and a method by which the user can evaluate the available packages and select the one most suitable for the intended application; and (6) methods for the interconnection of packages and assembly of circuits into components and systems. Author

N69-23226*# Texas Instruments Inc., Dallas.
RELIABILITY HANDBOOK FOR SILICON MONOLITHIC MICROCIRCUITS. VOLUME 2: FAILURE MECHANISMS OF MONOLITHIC MICROCIRCUITS
William O. Shurtleff Washington NASA Apr. 1969 35 p refs
(Contract NAS8-20639)
(NASA-CR-1347; Rept-03-67-04-Vol-2) Avail: CFSTI CSCL 09A

Defects are enumerated that are introduced into monolithic microcircuits during the various processes of manufacture; the impact of these defects on microcircuit failure rates and the techniques that are used to correct or remove the defects from the processes are considered. The techniques of processing that are used in the manufacture of monolithic microcircuits are sophisticated, numerous, and complex. There is a finite probability that defects are introduced at each step of the manufacturing process. These defects are of concern to both the manufacturer and the user of monolithic microcircuits in two major respects: (1) Defects reduce the effective yield of the manufacturer, thereby increasing the cost of each microcircuit bought by the user; and (2) Defects may cause microcircuit reliability problems which adversely affect the user's end product and the reputation of the microcircuit manufacturer. Author

N69-23258# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
THE EXTENDED RANGE GAP (ERG)
J. F. Howell 9 Oct. 1968 9 p
(Contract AT(29-2)-656)
(GEPP-48) Avail: CFSTI

The Extended Range Gap (ERG) is a cold cathode switching device that has the capability of switching up to several thousand amperes, with extremely low time jitter and delay, over an operating range of <300 to 30,000 volts. The performance characteristics of the ERG device and its circuitry are discussed. Author (NSA)

N69-23278# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Eastern Science and Technology Div.
R-F CONTROLLER, TYPE CC-372, NUMBER B-3763
James Mee 4 Mar. 1968 15 p
(Contract AT(29-1)-1183)
(EGG-1183-444) Avail: CFSTI

An improved fail-safe system for rf oscillator sources is described. The unit samples the rf output of the master oscillator and switches to the slave oscillator whenever the output of the master oscillator falls below a preset minimum level. NSA

N69-23279# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
AN INTEGRATED FAST AMPLIFIER WITH A HIGH INPUT IMPEDANCE
L. Papadopoulos 21 Oct. 1968 15 p refs
(ISS-68/38) Avail: CFSTI

A new voltage amplifier stage is presented which has the following characteristics: high input impedance and wide bandwidth. The detailed analysis of the circuit allowed the construction of an amplifier, which amplifies 85 times with an input impedance of ≈ 20 k Ω and a rise time smaller than 2.5 ns. This amplifier was mounted as an input stage after a filter which was used for measuring the zero-crossing point in a pulse shape discrimination circuit. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-21953 Syracuse Univ., N. Y.
ANALYSIS AND SYNTHESIS OF ASYNCHRONOUS CIRCUITS UNDER DIFFERENT DELAY ASSUMPTIONS
Glen George Langdon, Jr. (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-13842

Different constraints which may apply to the stray delays, such as zero line delays, bounded delays, and the use of delay elements were studied to determine the relationship between hazard-free sequential networks and speed independent circuits. It is shown that speed independent circuits may be described by flow tables, and the analysis and synthesis of these circuits is described. Various methods of analysis and synthesis applicable under the different criteria considered are presented. The allowed sequence graph is seen to detect critical races in the state branches. The

value of a stray delay is only in evidence during a signal change. The essential hazard is generalized to show in a delay-free circuit with line delays that the signals which may change during a transition may appear to change in any order. Thus, state assignments for delay-free circuits with line delays must be critical race-free minimum transition time. A NOR flip–flop AND gate realization procedure is sufficient for almost totally sequential state assignments under the bounded ratio delay assumption. Dissert. Abstr

N69-22056 Case Western Reserve Univ., Cleveland, Ohio.
THEORY AND APPLICATION OF MODAL CONTROL
Jerome David Simon (Ph.D. Thesis) 1967 241 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 68-10184

These concepts are shown to be alternate characterizations of Kalman's concepts of (state) controllability and observability. With the aid of these properties conditions for the existence and uniqueness of modal controllers are established. A general technique for modal control is developed. The property of modal decomposition allows a powerful recursive design procedure to be formulated which allows a control system to be designed in an evolutionary manner. This procedure is recursive in the sense that a selected number of modes are moved to desired locations at each iteration while the others remain fixed. State decomposition techniques are also presented which ease the computational requirements associated with the design of the controller. This technique is compared to other methods for shifting modes. A method is given for reducing the number of states that are required by the control law. Dissert. Abstr.

N69-22132 IIT Research Inst., Chicago, Ill.
A DESIGN PROCEDURE FOR STABLE THIRD ROOT CONTROLLERS
Gerald Allan Marazas (Ph.D. Thesis) 1968 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-14915

This dissertation represents an effort to use the results of modern control theory to design a regulator system which is of greater interest to control engineers. The optimal linear regulator forms the starting point and provides a basis for comparison in the present research. The optimal linear regulator is optimal in terms of minimizing an integral quadratic performance index. In particular this investigation centers on a control law containing a term proportional to the third root of regulator error and a term directly proportional to the regulator error. The design procedure of the third root controller is developed in terms of the Hamilton–Jacobi partial differential equation. A closed form solution is obtained for the cost function under third root control and an integral quadratic performance index. This means that the cost of third root control can be compared to the cost of optimal linear control. Dissert. Abstr.

N69-22248# Argonne National Lab., Ill.
THE EBR-2 FEEDBACK FUNCTION
R. W. Hyndman and R. B. Nicholson Jul. 1968 56 p refs
(Contract W-31-109-eng-38)
(ANL-7476) Avail: CFSTI

An attempt was made to deduce as much information as possible on the EBR-II feedback function from a series of oscillator and rod-drop experiments. Because of weak feedback and deficiencies in the experimental equipment, the results may contain significant errors. The accuracy and consistency of the feedback function estimates are discussed, and improvements for future experiments are suggested. NSA

N69-22488# National Bureau of Standards, Washington, D. C.
ABSOLUTE DETECTORS AND THEIR TRANSFER STANDARD PROBLEM IN THE VACUUM ULTRAVIOLET
Robert P. Madden *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 111–124 refs (See N69-22476 11-30)
Avail: CFSTI

Thermopiles have been studied extensively for their applicability as radiometric standards in the 500–2000 Å region. Under appropriate conditions and with suitable corrections it appears that they can be used reliably in this spectral region having been calibrated with black-body radiation in the visible. A thermopile and a rare gas ionisation chamber have been used to measure independently the same flux at 584 Å and 736 Å, with an agreement better than the estimated reliability of 9 per cent. A search is now under way to find a photocathode with a stable photoelectric yield which, in a photodiode, could serve as a convenient and reliable transfer detector standard for the region below 1400 Å. Completed studies prove conclusively that the photoelectric yield of an ultra-clean surface of tungsten can undergo a dramatic change when contaminated by as little as a fraction of a monolayer. That other photocathodes as well are sensitive to contamination is indicated by studies of the effects of ageing and heating on the photoelectric yield of several materials (e.g. gold, chromium) under ordinary vacuum conditions. Anodised aluminium films show promise as surfaces which have a reliable photoelectric yield. Author (ESRO)

N69-22487# Air Force Cambridge Research Labs., Bedford, Mass.
ABSOLUTE PHOTOELECTRIC YIELD OF TUNGSTEN BETWEEN 31.6 AND 304 Å
L. J. Heroux and M. Cohen *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 125–135 refs (See N69-22476 11-30)
Avail: CFSTI

The AFCRL monochromators that are used to measure the absolute intensity of solar radiation below about 1250 Å are calibrated by illuminating the grating of the monochromator with monochromatic radiation and recording the counting rate produced by this radiation. The absolute rate of photons incident on the grating is determined from the photoelectron emission current of a reference tungsten cathode used as a secondary standard. This technique requires knowledge of the absolute photoelectric yield of the reference cathode. The absolute yield of commercial tungsten which has been polished, cleaned, and exposed to a pressure of about 106 torr is now known with an uncertainty of ±30 per cent over the wavelength region 1100 Å – 400 Å. The measurement of the absolute yield of tungsten at several shorter wavelengths between 304 Å and 31.6 Å will be discussed here. The absolute photon rate of a monochromatic beam was determined with a thin-window Geiger-Müller counter developed by Ederer and Tomboulian. A Bendix M306 photomultiplier with a tungsten cathode was illuminated at normal incidence with this photon beam and the counting rate of the photomultiplier determined. To correlate the measured counting rate with the cathode photoelectron emission rate, an independent measurement of the photoelectron counting efficiency of the photomultiplier was determined. Author (ESRO)

N69-22489# GCA Technology Div., GCA Corp., Bedford, Mass.
PHOTO-IONISATION PROCESSES RELATED TO ABSOLUTE INTENSITY MEASUREMENTS
James A. R. Samson *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 137–144 refs (See N69-22476 11-30)
Avail: CFSTI

A complete understanding of photon absorption processes in the rare gases is desirable if rare gas ionisation chambers are to be used to measure absolute intensities in the vacuum ultraviolet. Absorption processes have been studied using the new technique

of photo-electron spectroscopy. With this method it is possible to determine from which atomic orbital the electron is ejected and its precise kinetic energy. Further, it is possible to determine the relative numbers of electrons within each energy group. Results are given of the total number of s- and p- electrons ejected from the outermost shells in the photo-ionisation process. Extending this technique into the soft X-ray region, one can determine suitable wavelength regions for which the ion chamber can be used to measure absolute intensities. The production of secondary electrons by energetic photo-electrons limits the use of the ion chamber at short wavelengths. When using helium, the threshold for producing secondary electrons occurs at approximately 280 Å and no plateau occurs in the ion versus voltage plot. However, under appropriate conditions a plateau exists for wavelengths down to 250 Å. This anomaly is explained by the fact that the ejected photo-electrons excite helium and lose their energy before they can gain sufficient energy from the ion chamber field to produce secondary electrons.
Author (ESRO)

N69-22829# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
ELECTRONIC CIRCUIT FOR TEMPERATURE CONTROL [CIRCUITO ELETTRONICO PER IL CONTROLLO DELLA TEMPERATURA]
C. Felici 5 Oct. 1968 12 p refs In ITALIAN; ENGLISH summary
(ISS-68/34) Avail: CFSTI

An electronic circuit is described by which a uniform temperature control is obtained through a continual and automatic regulation of the current in the heating element. Author

N69-22919*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SYMBOL-ORIENTED FAILURE ANALYSIS IN MULTICOMPONENT SYSTEMS
Milton C. Weinstein and W. W. Happ Washington Apr. 1969 16 p refs
(NASA-TN-D-5112) Avail: CFSTI CSCL 09F

Computer oriented procedures are developed to assess the error in performance of electronic circuits and similar quasilinear systems if one element in a multicomponent system fails. A tutorial introduction to tagging techniques is provided to make the presentation self-contained. Author

N69-22944# Case Western Reserve Univ., Cleveland, Ohio. Systems Research Center.
GENERALIZED CONTROLLABILITY FOR PERTURBED LINEAR SYSTEMS
Michel Claude Delfour Jun. 1968 106 p refs
(Grant NSF GK-1394)
(PB-180716; SRC-68-5) Avail: CFSTI CSCL 12A

The term controllability was defined so it could be extended to the perturbed case. For perturbed linear systems, in addition to geometrical and analytical necessary and sufficient conditions for controllability, some other significant results were obtained: impossibility of strict controllability when disturbances are present, existence of a minimum bound on the size of the elements of the control set to insure controllability; existence of a maximum bound on the size of the elements of the disturbance set to insure controllability, existence of a minimal 'target size' to insure controllability, analytical equations to find the above parameters, and method of decomposition of the analytical equations arising from the previous problems to simplify their numerical solution.
Author (USGRDR)

N69-23101# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
THE USE OF STOCHASTIC AUTOMATA IN ADAPTIVE CONTROL
I. Joseph Shapiro and Kumpati S. Narenda Dec. 1968 71 p refs
(CT-23) Avail: Issuing Activity

The application of stochastic automata to adaptive parameter optimization problems is considered. The fundamental problem is that of relating the concepts of automata theory and mathematical psychology learning theory to the usual notion of a performance index in a control system. Consideration is given to a number of possible automata structures, linear and non-linear. One particular linear model and a modified version are derived with optimal rather than expedient properties of convergence. A basic feature of this model is that it is based on a system response set of rewards and inactions, the latter being substituted for the more common penalty responses. This choice of response set is directly related to the achievement of the desired behavior. Simulations are described for the maximization of multimodal performance functions, intentionally constructed to demonstrate the use of the method in situations where relative extrema occur. Examples are also given of the automaton in the dynamic context, as a direct adaptive controller for a control system, and as a second-level global supervisor of a local gradient search. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-22197# Texas A&M Research Foundation, College Station.
LIGHT GAS GUN CALIBRATION REPORT, PROJECT 507-1
S. H. Carpenter and L. J. Thompson 1 Aug. 1968 14 p
(PB-180866; SC-CR-68-3753) Avail: CFSTI CSCL 14B

The theoretical equation used to design the gas gun was never experimentally verified. The purpose of this report is twofold. The small gas gun will be used to verify the accuracy of the theoretical study from which the design of the large gas gun was taken. Secondly, the small gas gun will be used to predict the accuracy with which a gas gun will be able to reproduce a given velocity under stated conditions. Author (USGRDR)

N69-22314# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
ATMOSPHERIC ENTRY TEST FACILITIES: LIMITATIONS OF CURRENT TECHNIQUES AND PROPOSAL FOR A NEW TYPE FACILITY Final Report
J. Lukasiewicz Jan. 1969 55 p refs
(Contract (F40600-69-C-0001)
(AD-681487; AEDC-TR-68-240) Avail: CFSTI CSCL 14/2

The theoretical and practical limitations of various types of wind tunnels, aeroballistic ranges, and counterflow facilities are examined in terms of velocity-altitude duplication. It is concluded that these aerodynamic test facilities can not provide the desired low altitude, orbital-to-escape-velocity capability to test the atmospheric entry phenomena associated with large models. It is suggested that this capability might be achieved by the application of rocket propulsion to aeroballistic-range-type testing. The proposed system for launching models consists of a multistage rocket booster

travelling inside a straight tube evacuated to a low pressure. On attainment of the desired velocity, the model proceeds into the test range which is a variable pressure tank that is instrumented for aerophysical, erosion, impact, stability, and drag studies. It is estimated that model/sabot packages weighing from 10 to 1 lb could be launched at speeds from 25 to 35 kft/sec, respectively. The proposed test technique as applied to lower hypersonic speeds, to the duplication of high Reynolds numbers, and to hypersonic ramjet testing is discussed. Author (TAB)

N69-22428# Stanford Linear Accelerator Center, Calif.
TWO-MILE ACCELERATOR PROJECT Quarterly Status Report, 1 Apr.–30 Jun. 1968
Aug. 1968 66 p refs
(Contracts AT(04-3)-400; AT(04-3)-515)
(SLAC-90) Avail: CFSTI

Development and operation of the SLAC 20-GeV electron linear accelerator and experimental facilities are discussed. Instrumentation and control, radiation detectors, plant engineering, klystron studies, mechanical engineering, and counting electronics are described. NSA

N69-22438# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
EXPERIMENTAL PLANT FOR INVESTIGATIONS OF GROUND EFFECTS ON V/STOL AIRCRAFT [VERSUCHSANLAGE FUER BODENEFFECT-UNTERSUCHUNGEN BEI KURZ- UND SENKRECHTSTARTERN]
H. Dissen and E. Schwantes 3 Oct. 1968 28 p refs In GERMAN; ENGLISH summary
(DLR-Mitt-68-29) Avail: CFSTI

An investigation plant for ground effects is described which was developed in 1968 in the research field of the DFL–Institut fur Strahlantriebe in Braunschweig. These effects are induced by the hot jets of the propulsion systems of V/STOL–Aircrafts. It is shown how the facilities work, which simulate the mass flow into the engine inlet and the heating of the propulsion jet (close to 1000°C). The new light plane projector, which makes visible the field of the recirculation streams, is introduced too. The intended theoretical and experimental works are explained. Author

N69-22508# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Strahlantriebe.
TEST APPARATUS FOR THE INVESTIGATION OF PRESSURE TRANSDUCERS DURING DYNAMIC GAS LOADING [TESTGERAET ZUR UNTERSUCHUNG VON DRUCKGEBERN BEI DYNAMISCHER GASDRUCKBELASTUNG]
W. Buschulte and H. Koch Sep. 1968 22 p In GERMAN; ENGLISH summary
(DLR-MITT-68-24) Avail: CFSTI

A test apparatus suitable for the investigation of electro-mechanical pressure transducers under dynamic load is described. This apparatus develops oscillating pressure modes as they are observed for example in rocket motors. Some characteristics of the apparatus have been investigated in the frequency range from 80 to 800 Hz and up to 50 kp/cm^2 pressure. Further on the example of a pressure transducer testing has been described. Author (ESRO)

N69-22523# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
VELOCITY READOUT SYSTEM FOR AN IMPACT TEST MACHINE
J. J. Henry 4 Jun. 1968 10 p
(Contract W-7405-ENG-26)
(Y-1619) Avail: CFSTI

A noncontact velocity readout system for an impact test machine has been designed. This system measures velocity with an optical-electronic-generated, time-interval measurement from a distance template. An accuracy of ±0.05 ft lb has been obtained. Calibration data for the system have been determined. Author (NSA)

N69-22624# California Univ., Livermore. Lawrence Radiation Lab.
PLATINUM WORKING ELECTRODE CELL FOR CONTROLLED-POTENTIAL COULOMETRY
J. E. Harrar 27 Mar. 1968 7 p refs
(Contract W-7405-ENG-48)
(UCRL-50417) Avail: CFSTI

Construction and operational details are given for a platinum working electrode cell assembly suitable for controlled-potential coulometry and electrolysis. The cell, designed for electrolyses of milligram quantities of material, features a glass cell with a threaded Teflon cap. Author

N69-22625# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
EVALUATION OF THE ASDE BRIGHT DISPLAY Final Report
Robert L. Tarr Apr. 1969 34 p
(NA-69-20; (RD-69-15)) Avail: Issuing Activity

Field tests were conducted to evaluate the operational use of a bright display for presentation of Airport Surface Detection Equipment (ASDE) radar information in a control tower cab and to determine the effect of the addition of the solid state duplexer on the maintainability and reliability of the radar. The bright display consisted of a vidicon camera pickup of the ASDE presentation from a modified ASDE-2 indicator in the tower equipment room and transmission of this information via closed circuitry to a bright display located in the tower cab. Controller opinion indicated that the ASDE Bright Display was a desirable control tool. This was attributed to the fact that (1) the display presentation was usable in all ambient light conditions and (2) to the smaller cabinet size of the TV monitor for a given screen diameter as compared to the conventional ASDE-2 console. It was recommended that the ASDE Bright Display be adopted for use in airport control towers. Author

N69-22629*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A RENDEZVOUS AND STATION-KEEPING SIMULATOR WITH FLY AROUND CAPABILITY AND VIRTUAL IMAGE VIEWING
William M. Kahlbaum, Richard E. Bardusch, and John J. Stumpf Washington Apr. 1969 40 p refs
(NASA-TN-D-5123) Avail: CFSTI CSCL 14B

A screen-type-refractive-virtual-image rendezvous simulator has been designed and built at the Langley Research Center. In this simulator, the test subject views combined images of a celestial background, a featureless earth horizon, and a rendezvous target vehicle through a circular window with a 30° field of view. The virtual images of the horizon and stars appear to be at infinity, while the target-vehicle image appears to be at some closer distance. The three elements of the display are rear projected on screens by means of separate gimbaled projectors. The horizon and star images are generated optically, while the target-vehicle image is generated by a closed-circuit television system. The observed size of the target-vehicle image varies as a function of problem range. Range changes within 160 meters of the observer are simulated by moving the television camera along a range bed. Range changes beyond 160 meters with satisfactory television line resolution are simulated by continuously shrinking the raster on the television projection tube. Since the problem requires three degrees of continous rotational freedom for the observer, a central computer

program generates attitude information (by means of quaternion rate equations) and presents this information to the simulator in the form of direction cosine matrices. Author

N69-22647# General Electric Co., Schenectady, N. Y. Research and Development Center.
HIGH-PURITY GERMANIUM FOR GAMMA DETECTORS Annual Report, Jun. 1967–Apr. 1968
R. N. Hall, R. D. Baertsch, and T. J. Soltys May 1968 7 p refs
(Contract AT(30-1)-3870)
(S-68-1088; AR-1; NYO-3870-1) Avail: CFSTI

Experimental equipment and procedures for purifying germanium for use in p–i–n junction gamma detectors are described. The crystal growing furnace is described, and procedures for controlling impurities are discussed including crucible, furnace atmosphere, chemical processing, dust, source germanium, and intrinsic defects. Also, preparation of p–i–n detectors is outlined. NSA

N69-22649# California Univ., Berkeley. Lawrence Radiation Lab.
ECONOMIC FACTORS INVOLVED IN THE DESIGN OF A PROTON SYNCHROTRON OR STORAGE RING WITH A SUPERCONDUCTING GUIDE FIELD
Michael A. Green 31 Jul. 1968 29 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-18186) Avail: CFSTI

The most important economic considerations involved in the design of a superconducting synchrotron are discussed. The cost of all the important accelerator components is estimated for a number of types of accelerators. The effect of the important machine parameters on machine cost is discussed. The important physical and economic differences between superconducting and conventional synchrotrons are presented. The effect of these differences on the design of machine is investigated. The importance of the ac loss is discussed. In conclusion, this report shows that a number of the machine parameters should be determined by economic factors rather than by fiat. Author (NSA)

N69-22807# Rome Univ. (Italy).
PRELIMINARY STUDY OF THE CHARACTERISTICS OF A STREAMER CHAMBER [STUDIO PRELIMINARE DELLE CARATTERISTICHE DI UNA CAMERA A STREAMER]
N. M. Beneventano, M. Del Priori, F. de Notaristefani, P. Monacelli, F. Sebastiani et al 9 Jul. 1968 21 p refs In ITALIAN *Its* Note No. 176
(NP-17697) Avail: AEC Depository Libraries

A streamer chamber controlled by a Blumlein type pulse generator, which permits the duration of the high voltage pulse to be varied, at will, is described. The apparatus consists essentially of a streamer chamber, a high-voltage pulse former fed by a voltage multiplier operated by two spark chambers in coincidence. Each of these constituents is described. NSA

N69-22820# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. High Energy Lab.
LOW BACKGROUND COUNTING ROOM AND ANCILLARY APPARATUS
W. Burrells Mar. 1968 15 p ref
(RHEL/R-161) Avail: CFSTI

A suitable thermal and radiation shield was sought for a room in which low background spectrometry could be carried out. A chalk block structure, housing counting castles constructed from parts of pre-1939 naval guns, was built, with all heat-generating apparatus sited outside the shield. Author (NSA)

N69-22857# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
MEASUREMENT OF THE OPTIMAL FREQUENCY-AMPLITUDE CHARACTERISTIC OF THE 680 MeV SYNCHROCYCLOTRON
I. B. Enchevich and T. N. Tomilina 1968 14 p In RUSSIAN
(JINR-P9-3969) Avail: CFSTI

A method is suggested to determine the optimal frequency-amplitude characteristic of the synchrocyclotron high-frequency system without breaking the vacuum. The characteristic is read from the going accelerator, so all the factors, which affect the accelerator operation, are taken into account. As such an optimal amplitude, from the point of view of energy consumption, we consider the minimal amplitude which does not cause the decrease of the intensity of the particle beam with a maximum energy. Author (NSA)

N69-22900# European Organization for Nuclear Research, Geneva (Switzerland).
THE SECOND STAGE CPS IMPROVEMENT STUDY. EIGHT HUNDRED MeV BOOSTER SYNCHROTRON
3 Oct. 1967 239 p refs
(MPS/Int.DL/B-67-19) Avail: CFSTI

Improvements proposed for the Cern Proton Synchrotron (CPS) in order to increase the protons accelerated per cycle are described. Proposed improvements were the construction of an 800 MeV booster synchrotron between the 50 MeV linac and the CPS as well as modifications on the linac and the CPS. The research program for the CPS is outlined. NSA

N69-22979# Los Alamos Scientific Lab., N. Mex.
FLUX PUMP AT WORK AT LOS ALAMOS
H. L. Laquer [1968] 13 p refs Presented at Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 3 Jul 1968
(Contract W-7405-ENG-36)
(LA-DC-9820) Avail: CFSTI

The developmental work on flux pumps from its initial stages to the present is outlined. NSA

N69-22981# National Inst. for Research in Nuclear Science, Chilton, England. Rutherford High Energy Lab.
NIMROD OPERATION AND DEVELOPMENT Quarterly Report, 1 Oct.–31 Dec. 1967
D. E. Gray, ed. 1968 24 p refs
(RHEL-R-162) Copyright. Avail: CFSTI

The Nimrod beam was on for high energy physics research for 80.94% of the scheduled operating time. Two experiments were completed; two continued through, and four were commenced. Some notes on the operation of the X1 and X2 extracted proton beams are given. Radiation dosimetry associated with Nimrod is discussed. Construction of the X2 secondary beam complex is described. A report on the first operational run of the 80 cm helium bubble chamber is included. Author (NSA)

N69-22989*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPLODING WIRE INITIATION AND ELECTRICAL OPERATION OF A 40-kV SYSTEM FOR ARC-HEATED DRIVERS UP TO 10 FEET LONG
Robert E. Dannenberg and Anthony F. Silva Washington Apr. 1969 41 p refs
(NASA-TN-D-5126) Avail: CFSTI CSCL 14B

This report describes an energy storage and electric arc driver system for shock driven facilities. Energy for the arc is supplied from a capacitor bank rated at 1 MJ at an operating voltage of 40 kV. Results are presented for arc discharge lengths of 54 and 116 inches with peak currents of 800 kA. The entire

arc strike sequence of exploding wire initiation, dwell period, and subsequent bank discharge is discussed. The effect of different wire types on arc initiation is also discussed. The composition of the driver gas is shown to be a factor limits the discharge of stored energy from the capacitor bank. Author

N69-23108# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

AN ANALYSIS OF THE BRAYTON CYCLE AS A CRYOGENIC REFRIGERATOR

R. C. Muhlenhaupt and T. R. Strobridge Aug. 1968 119 p refs (NBS-TN-366) Avail: SOD $1.25

The performance of a Brayton cycle refrigerator was computed, taking into account the efficiencies of the various components. The results are presented in graphical form. These charts give the input power requirements, mass flow rate, and pertinent temperatures, and allow selection of the optimum high pressure for a given set of component characteristics. Author

N69-23160# European Organization for Nuclear Research, Geneva (Switzerland).

DYNAMIC CHARACTERISTICS OF A 70-GeV PROTON SYNCHROTRON ACCORDING TO MAGNETIC MEASUREMENTS [CARACTERISTIQUES DYNAMIQUES DU SYNCHROTRON A PROTONS DE 70 GEV D'APRES LES MESURES MAGNETIQUES]

V. I. Balbekov and I. A. Shukeilo 1968 29 p Transl. into FRENCH from Russian Report IHEP-67-58-K In FRENCH (CERN-Trans-68-7; IHEP-67-58-K) Avail: CFSTI

The effects of the deviations of the magnetic field from the distribution predicted on the movement of the particles in the Serpukov IHE proton synchrotron are considered. The calculations showed that the important azimuthal inhomogeneities of the magnetic field and the gradient are produced only at the beginning of the acceleration cycle. The half-length of the parametric resonance band for the cycle initiation field is 0.03 (in number of oscillations per revolution). When the totality of the separator is occupied, the parametric effects can cause a particle loss. The betatron oscillation frequencies are, at the interior of the work for the complete cycle duration. For H > 11,000 oersteds, the magnetic field gradient decreases because of the saturation of the magnet poles, which causes a reduction of the betatron frequencies. It is precisely this effect which determines the limiting energy of the particles. Author (NSA)

N69-23160# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).

CONCERNING THE CROSSING OF PARAMETRIC RESONANCE IN ACCELERATORS WITH INTENSIVE BEAMS

V. I. Balbekov and I. A. Shukeilo 1967 21 p refs in RUSSIAN (IFVE-SKU-67-35-K) Avail: CFSTI

A growth of betatron oscillations in cyclic accelerators is investigated when the betatron number is crossing the line of parametric resonance due to Coulomb interaction of particles. A dependence of the charge density on the particle position in a bunch results in a multiple crossing of the resonance. The approximate solution of the equation of betatron oscillations is obtained, and the particle losses are calculated. The general theory is illustrated by calculations for the Serpukhov 70GeV proton synchrotron. Author (NSA)

N69-23171# Federal Aviation Administration, Washington, D. C. Systems Research and Development Service.

BENEFIT/COST ANALYSIS OF APPROACH LIGHTING SYSTEMS

John C. Kal Mar. 1969 47 p refs (RD-69-23) Avail: Issuing Activity

This analysis provides information on how to place newly developed lower cost approach lighting systems into the National Airspace System. Candidate locations are identified by airport instrument approach levels reflecting weather minimums occurrence and benefit–cost relationships. Author

N69-23184*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

VISUAL SIMULATION IMAGE GENERATION USING A FLYING-SPOT SCANNER

Charles A. Wagner Washington Apr. 1969 58 p refs (NASA-TN-D-5151) Avail: CFSTI CSCL 14B

The flying-spot scanner television camera used as a video signal generator for visual flight simulation is analyzed. A description of the technique is included as well as a detailed theoretical analysis of the quality of the video that can be produced. A commercially available flying-spot scanner designed for flight simulation was tested, and its capabilities are presented. Discussion is limited to the television camera; display devices such as monitors are not included. The flying-spot scanner was found to be a low-cost device which can simulate all motions of an aircraft except roll. Large excursions at high rates are easily achieved. It is limited to a relatively small field of view, a fixed forward visibility, and simulation of flat terrain. The quality of the video is adequate over a moderate range of altitudes; very high and very low altitudes result in poor performance. Possible approaches to increasing the useful altitude range are discussed. Author

N69-23206# Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Institut fuer Elektronik.

PRECISION PULSE GENERATOR FOR THE SIMULATION OF RADIATION DETECTOR PULSES

W. Attwenger, G. Gruber, and R. Patzelt [1968] 13 p refs (SGAE-E-11/1968) Avail: CFSTI

To reach the highest precision (linearity and stability) pulse amplitude, a pulse generator must be designed with a minimum of active components. Normally a mercury-wetted relay is used together with a R-C combination as a pulse shaping network. If a transistor is used as a switch, a repetition rate up to 10,000 pulses per second can be obtained. The time-jitter between control signal and output pulse is avoided, which is inherent when a relay is used. A modified design of the pulse shaper allows the use of the transistor with the emitter grounded. The stability of the output amplitude depends principally on the collector–emitter saturation voltage U_{CES}. The dependence of U_{CES} on I_B, I_C and T has been investigated. The output amplitude is stable within 10^{-4}, the linearity is better than 10^{-3} of full scale. Author

N69-23238# Texas Univ., Austin. Engineering Mechanics Research Lab.

EXPLOSIVE-DRIVEN FLYING PLATE PLANE-WAVE GENERATOR Final Report

Philip Llewellyn Stanton 6 May 1968 157 p refs Prepared for Sandia Corp.

(PB-180747; EMRL-1058; SC-CR-68-3672) Avail: CFSTI CSCL 20K

A simple, compact device for generating plane stress waves in materials is considered. The device uses a relatively small explosive charge to propel a metal flyer to flat impact on a flat surface. The impact velocity may be varied over a range of approximately 0.2 to 2.0 millimeters per microsecond, by adjusting certain design parameters. The impact may be varied from approximately 0.1 to 0.6 microseconds. Author (USGRDR)

N69-23272# Ceskoslovenska Akademie Ved. Rez. Ustav Jademeho Vyzkumu.
POLYNOMIAL EXPRESSIONS OF ELECTRIC AND MAGNETIC FIELDS INTENSITY IN A HORIZONTAL PLANE OF A CYCLOTRON
A. Grda and M. Kuzmiyak Mar. 1968 33 p refs in CZECH (UJV-1903) Avail: AEC Depository Libraries

A polynomial expression was derived for the intensity of electric and magnetic fields in cyclotrons. General formulas, polynomial coefficients, approximating the course of electric field intensity, and Giar–Algol programming for polynomial coefficients which approximate radial intensity drop in cyclotron magnetic field, are given. The results of polynominal calculations for U-120 cyclotron are presented. The expressions obtained may be used for analysis of initial particle trajectories in a cyclotron and for implicit studies of particle kinematics in the cyclotron horizontal plans during the whole acceleration process. Author (NSA)

N69-23296# National Research Council of Canada, Ottawa (Ontario).
PRODUCTION AND DISCHARGE OF TOXIC AND RADIOACTIVE GASES LINAC TUNNEL IN FRASCATI
M. Ladu, M. Pellicioni, and M. Roccella 1968 13 p refs Transl. into ENGLISH from Italian Report LNF-65/21 NRC-TT-1332; LNF-65/21) Avail: CFSTI

The production of the toxic gases nitrogen dioxide and ozone and the nuclides oxygen-15, nitrogen-13, and chlorine-38 in the Francati 400-MeV linac tunnel is calculated, and the ventilation requirements are calculated to ensure concentrations below the maximum admissible levels for personnel safety. NSA

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-21976 Stanford Univ., Calif.
EFFECTS OF NON-UNIFORM INLET VELOCITY PROFILES ON FLOW REGIMES AND PERFORMANCE IN TWO-DIMENSIONAL DIFFUSERS
Seigbert Wolf (Ph.D. Thesis) 1967 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.00 Order No. 68-11384

The effects of large distortions of inlet velocity profiles on flow regimes and performance in diffusers is reported. Both theoretical and experimental results are given. An inviscid analysis of rotational flow is developed in sufficient generality to establish trends of performance of any diffuser geometry with an arbitrarily specified non-uniform inlet velocity profile. The experimental program is restricted to flow in straight two-dimensional diffusers with turbulent boundary layers. Systematic data on flow regimes and performance are obtained for two general types of inlet flows: (1) simple, uniform shear flows in the core, and (2) severely non-uniform shear flows of the wake, jet and step-shear type. Diffuser performance is correlated and compared to predictions afforded by the analysis of inviscid rotational flow and other simplified diffusion models. Geometry and performance correlations for peak pressure recovery (at constant N/W_1) are also established. Dissert. Abstr.

N69-21983 Houston Univ., Tex.
TURBULENT GAS FLOW OVER A SIMULATED LIQUID INTERFACE
Richard Neal Houze (Ph.D. Thesis) 1968 318 p
Avail: Univ. Microfilms: HC $14.40/Microfilm $4.10 Order No. 68-13801

An examination of the applicable equations of motion and the dynamic equations for the one and two point turbulent velocity correlations elucidated several effects of a periodic boundary motion on the characteristics of the superposed turbulent gas flow. Experimental measurements were employed to confirm these affects and obtain a detailed description of the turbulent flow field. Large effects of boundary roughness and motion were observed in the time averaged turbulent flow properties of pressure gradient, mean velocity profile, turbulence intensities, and turbulent shear stress. The most significant effects were observed in the statistical properties of the turbulent kinetic energy components and the turbulent shear stress. Boundary motion causes the appearance of a complex periodic motion in the flow field which interacts with the turbulent motions to produce important changes in the composite turbulent motions. Dissert. Abstr.

N69-21986 Yale Univ., New Haven, Conn.
NON-EQUILIBRIUM SHOCK STAND-OFF DISTANCE OF A BLUNT BODY IN DISSOCIATING GAS FLOW
George Buzyna (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-11163

An experimental investigation of the nonequilibrium behavior of the shock standoff distance ahead of spheres is described. Wind tunnel experiments using a known model gas mixture with a single relaxation process are discussed. A marked variation of the dimensionless shock standoff distance with a nonequilibrium parameter in identical free streams is observed. Qualitatively, the results are found to be in agreement with theoretical predictions in the literature. A new application of the Ludwieg tube intermittent supersonic wind tunnel to the study of nonequilibrium flow is presented. Dissert. Abstr.

N69-22030 Virginia Polytechnic Inst., Blacksburg.
SOLUTIONS OF THE SECOND-ORDER BOUNDARY-LAYER EQUATIONS FOR LAMINAR INCOMPRESSIBLE FLOW
Michael Joseph Werle (Ph.D. Thesis) 1968 188 p Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-12861

The solutions of Van Dyke's second-order boundary-layer equations for laminar incompressible flow are considered in detail. Solutions are obtained through application of three concepts which have proven useful at the first order level: self-similarity, local similarity, and the momentum integequation. The first of these allows accurate numerical solutions of the governing equations and detailed study of the four second-order contributions; namely, those due to vorticity interaction, displacement speed, longitudinal curvature, and transverse curvature. The present study derives the most general form of the self-similar equations permissible and, as such, is found to contain all previous self-similar solutions as members of subsets of a much larger family of solutions. In particular it is found that the vorticity interaction contribution is always self-similar if the first-order solution is. Dissert. Abstr.

N69-22033 Stanford Univ., Calif.
TWO-DIMENSIONAL DIFFUSER PERFORMANCE WITH SUBSONIC, TWO-PHASE, AIR-WATER FLOW
John Evan Hench (Ph.D. Thesis) 1968 217 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-11306

The pressure recovery performance of straight-wall, two-dimensional diffusers with air-water mixtures has been investigated, and their behavior as a function of gas volume flow ratio, β, and diffuser geometry, established within the limits of the experimental apparatus which was designed and built especially for

this study. The ranges of parameters investigated were: gas volume flow ratio, 0 to 73%; area ratio, 1.3 to 4; and diffuser length to throat width ratio, 3, 6, and 18. Dissert. Abstr.

N69-22039 California Univ., Berkeley.
ANALYSIS OF TRANSIENT FLUID FLOW IN MULTI-LAYERED SYSTEMS
Iraj Javandel (Ph.D. Thesis) 1968 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-13915

An analytical solution was derived which gives the potential distribution in an infinite, two layer aquifer with cross flow that is pumped by a partially penetrating well at a constant rate of discharge. It has been assumed that the lower layer is very thick relative to the upper layer, and the well is open in only part of the upper layer. The theory of the finite element method was reviewed and extended so as to enable analysis of transient fluid flow in multilayered systems with cross flow. To demonstrate its validity, non-steady state results obtained by the finite element method were compared and found to be in excellent agreement with results of typical boundary value problems for which analytical solutions are available. The finite element method was then used to investigate complex problems of transient fluid flow in layered systems. Cases with both complete and partial penetration in the pumping well have been successfully analyzed. Dissert. Abstr.

N69-22043 Texas A&M Univ., College Station.
A THEORETICAL METHOD FOR REPRESENTING THE GAS DYNAMIC FORCES AND CONVECTIVE HEAT TRANSFER PROPERTIES FOR CONCAVE BODIES IN HIGH SPEED RAREFIED GASES
Clarence Ray Wimberly (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-11482

An analysis is performed on concave surfaces in high speed rarefied gases where the surfaces are oriented at an arbitrary angle of attack. A general procedure is presented for representing the force and heat transfer properties for concave bodies in free molecule flow. The molecules are assumed to obey Maxwell's velocity distribution law before and after collisions, reflecting directionally in a cosine distribution. The colliding molecules are assumed to be perfectly accommodated to the surface conditions where the surface temperature is uniform. The resulting general equations are presented and applied to some simple concave bodies and compared in part with other theoretical values. Force and heat transfer coefficients are plotted for the sphere, cylinder and wedge as a function of angle of attack for various values of the molecular ratio and two values of the wall-to-ambient temperature ratio. Dissert. Abstr.

N69-22045 California Univ., Berkeley.
FLUID FLOW IN SATURATED POROUS ELASTIC MEDIA
Ranbir Singh Sandhu (Ph.D. Thesis) 1968 121 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-13953

Coupled flow in saturated elastic media is examined on the basis of the theory of mixtures. A variational principle is developed for the linear initial boundary value problem, and the finite element method is applied to generate approximate solutions to one and two-dimensional problems with complex geometry and arbitrary boundary conditions. Dissert. Abstr.

N69-22066 West Virginia Univ., Morgantown.
POWER-LAW FLUIDS FLOW THROUGH MULTIPARTICLE SYSTEMS
Yi-Hsiung Yu (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-13741

Equations for pressure drop, minimum fluidization velocity and bed expansion were obtained by extending the Blake–Kozeny equation for flow of power-law fluids through fixed and fluidized beds. The Richardson–Zaki theory was extended to obtain a drag force relation. These relations were compared with the experimental data. The study was limited to flow in the laminar region. Dissert. Abstr.

N69-22083 Illinois Univ., Chicago.
TURBULENT FLOW OF SUSPENSIONS OVER PARALLEL PLATES
James Joseph Szukel (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-12201

An investigation of turbulent suspension flow (14μ magnesia in air) over parallel plates was made for various flow velocities, plate spacings and mass flow ratios of solids to air. Experiments were carried out in a 12 inch square wind-tunnel with air velocities of 67, 83 and 100 ft./sec., plate spacings of 2, 1, and 1/4 inch, and mass flow ratios up to 0.1 lbm particles/lbm air. The nature of the developing turbulent boundary layer flow was such that the density of the particle was higher at the wall. Similarity parameters were examined for correlating the particulate flow measurements. It was concluded that the gas-particle momentum number, diffusivity number, and Reynolds number are pertinent for particle velocity correlation while the electroviscous number becomes an additional parameter where electric field forces become large. Dissert. Abstr.

N69-22097 Oklahoma Univ., Norman.
VIBRATIONAL RELAXATION OF CARBON MONOXIDE IN NON-EQUILIBRIUM NOZZLE FLOW
Charles Walter von Rosenberg, Jr. (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-14213

The vibrational relaxation of carbon monoxide was studied under conditions of rapid non-equilibrium expension by using a shock tunnel to generate a nozzle flow with stagnation temperatures of 2000° to 4500°K. Experiments were performed in pure CO and in a mixture of 5% CO + 95% Ar. The vibrational temperature of CO in the supersonic region of the nozzle was found from measurements of the first overtone emission at 2.3 μ by using a calibrated infrared detection system. From the data it was inferred that $\tau_{shock}/\tau_{expansion} = \phi \leq 5$ where τ_{shock} is that value of the relaxation time measured behind incident shock waves. Impurities were found to play a more important role in this type of experiment than in measurements of relaxation time behind shock waves mainly because of additional ways of their getting into the flow. Hydrogen atoms were found to be about four orders of magnitude more efficient in relaxing CO than CO is in relaxing itself at temperatures around 1500°–2000°K. Dissert. Abstr.

N69-22109 Washington State Univ., Pullman.
DYNAMICS OF FREE AXISYMMETRIC LIQUID SHEETS
John Chao-Piao Huang (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-10962

The dynamics of free axisymmetric liquid sheets formed by the collison of two coaxial jets were investigated experimentally and analytically. High-speed still and motion pictures were taken. Three breakup regimes of the liquid sheets were found when the Weber number (We) is varied from 100 to 3×10^4. In the first breakup regime (100 to 500), liquid beads formed along the nearly circular periphery of the sheet. In the first half of the transition regime (500 to 800), the cusp-shaped edge was found to coincide with cardioidal wave lines. When We < 800, liquid sheets are stable). In the critical zone of the transition regime (800 to 10^4), liquid sheets are generally stable. In the second half of the

transition regime (10^3 to 2×10^3), the liquid sheet becomes slightly unstable. In the second breakup regime (2×10^3 to 3×10^4), liquid sheets are distinctly unstable. Dissert. Abstr.

N69-22120# Lund Inst. of Tech. (Sweden). Machine Elements Div.

ON THE BALL FLOWMETER AND THE BALL VISCOSIMETER

Leif Floberg 2 Mar. 1968 31 p refs *Its* Acta Polytech. Scand., Mech. Eng. Ser. No. 36

(PB-180789; APS-ME-36) Avail: CFSTI CSCL 20D

The hydrodynamic lubrication theory is used to determine the conditions of a ball in a tube filled with viscous liquid. Special consideration has been taken to the existence of cavitation regions. The problem of a ball in a tube is applicable in two different cases, namely the ball flowmeter, where the location of a ball in a conical tube gives the amount of flow, and the ball viscosimeter, where the velocity of a ball falling in a tube with constant diameter is used to determine the liquid viscosity. The study is made for the non-cavitating case, and small clearance between the ball and the tube is assumed. Author (USGRDR)

N69-22128 Pennsylvania State Univ., University Park.

PARTICLE DEPOSITION FROM TURBULENT STREAMS BY MEANS OF THERMAL FORCE

R. Lee Byers (Ph.D. Thesis) 1967 122 p

Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-11971

Particle deposition from turbulent streams of hot gases was studied to determine what factors control particle collection. The effects of flow parameters and size of collector were determined and discussed. A mathematical model, based on existing theories of thermophoresis, was developed to predict collection efficiency. Dissert. Abstr.

N69-22141 Washington Univ., Seattle.

A STUDY OF THE SHEAR INDUCED LIFT FORCE ON ISOLATED AEROSOL DROPLETS

Donald Clifford Kolesar (Ph.D. Thesis) 1967 189 p

Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-9300

The motion normal to the fluid streamlines in a fluid undergoing laminar viscous flow with a large velocity gradient was studied. Effects due to the inherently nonlinear manifestation of fluid inertia in promoting a lift phenomena were sought in a theoretical model which featured a small translating particle immersed in an infinite, uniformly sheared fluid. The results of these derivations were inserted into the dynamic equation of particle motion to estimate droplet trajectories. Experimental confirmation of the trajectory and, therefore, motion due to fluid inertia was obtained. The derivation of the lift force employed small parameter perturbation techniques to a singular problem, the method of matched asymptotic expansions. The first order partial differential equation which contains the results of interest was solved by three dimensional Fourier transformations with the inversion integrals solved by LaPlace's asymptotic method and contour integration. The experimental results consisted of observation of the radial motion of droplets whose diameters ranged from 20 microns to 200 microns in vertically oriented tubes. This size range is considerably smaller and the fluid considerably less viscous than previously investigated; although limited experimental data exists for 1000 micron particles. Some justification exists for expecting a similarity between the lift observed for the larger particles and those studied herein. Dissert. Abstr.

N69-22176 State Univ. of New York at Buffalo.

FLOW OF A LIQUID IN A PARTIALLY FILLED SUDDENLY ROTATED CYLINDER

Herbert Otto Goller (Ph.D. Thesis) 1968 110 p

Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-11494

The investigation deals with the "spin-up" of the liquid partially filling a right circular cylinder which is impulsively accelerated from rest to a constant angular velocity. By application of certain assumptions, a simplification of the Navier-Stokes equations is obtained and numerically solved, obtaining the unsteady angular velocity distribution of the liquid and the configuration of the liquid's free surface as it approaches, asymptotically with time, a paraboloid. The simplifying assumptions are qualitatively verified by experiment. Measurement of the theoretically predicted free surface configuration is obtained by an electro-hyradulic servosystem designed and developed for the problem. Good agreement between experiment and theory is obtained. Dissert. Abstr.

N69-22192 Johns Hopkins Univ., Baltimore, Md.

ON INTERNAL GRAVITY WAVES

Yee-Chang Wang (Ph.D. Thesis) 1968 72 p

Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-10577

This theoretical analysis is concerned with internal gravity waves propagating in inviscid, incompressible, stratified fluids. The main properties—frequency relations, wave momentum, kinetic and potential energies—are studied. The equipartition of energy between the kinetic and potential energies is demonstrated. The dynamical conservation equations are derived, and based on them, the interaction between internal gravity waves and an unsteady, non-uniform current is analyzed. Two suggestions for the instability of internal gravity waves are discussed from a qualitative point of view. Dissert. Abstr.

N69-22206# Norwegian Inst. of Tech., Trondheim.

ON THE TURBULENT SWIRLING INLET FLOW IN A CIRCULAR PIPE

C. D. Ghildyal and Leif N. Persen 1968 54 p refs *Its* ACTA Polytech. Scand., Phys. Nucl. Ser. 57

(PB-180624; APS-PH-57) Avail: CFSTI CSCL 20D

The scope of the investigation is to find out if the law of the wall for turbulent boundary layers may be utilized to throw some light at the 3-dimensional turbulent pipe flow along the same line as that used for axial pipe flow. Author (USGRDR)

N69-22286# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

ON THE RESPONSE OF PRESSURE MEASURING INSTRUMENTATION IN UNSTEADY FLOW. (AN INVESTIGATION OF ERRORS INDUCED BY PROBE-FLOW INTERACTION)

Thomas E. Siddon Jan. 1969 96 p refs

(Grant AF-AFOSR-672A-67)

(AD-682296; UTIAS-R-136; AFOSR-68-2466) Avail: CFSTI CSCL 20/4

If a fast responding pressure probe of classical static probe geometry is placed in an unsteady flow it will not register the true instantaneous pressure interaction between the probe and the unsteady velocity field gives rise to an error between the measured pressure Pm(t) and the true pressure Pt(t). This error is not always small; it can in some circumstances be larger than the difference between Pt(t) and the ambient pressure. A major objective of the present work was to explore the possibility of correcting Pm(t) instantaneously, through use of an error-compensating probe. A probe configuration was adopted for which the error reduces to a simple form. The probe was devised to measure simultaneously the unsteady components of Pm(t) and Vn(t) over a wide frequency range. Output signals were processed by analogue means to correct out the error term providing an improved estimate of the true unsteady pressure. A series of experiments were conducted in a number of contrived unsteady flows. Major experiments involved a

periodic rotating inclined nozzle flow and some typical turbulent flows. The error-compensating scheme was found to be effective, particularly for the specialized rotating inclined nozzle flow. However the measurements in turbulent flows revealed that the correction to root-mean-square pressure fluctuation level was small, generally amounting to less than 20%. Author (TAB)

N69-22387# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE USE OF THE FABRY-PEROT INTERFEROMETER WITH WEDGELIKE ARRANGEMENT OF MIRRORS FOR THE STUDY OF LOW-DENSITY AIR FLOWS

A. I. Akimov and I. V. Skokov Aug. 1968 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 13, no. 6, 1967 p 941-944

(AD-681735; FTD-MT-24-208-68) Avail: CFSTI CSCL 20/4

An efficient new application of the Fabry-Perot interferometer to study the properties of low-density gas flows is described. The complete optical system is briefly described, together with experimental and measuring techniques. The visual picture of a circular cylinder of 10 mm radius in a supersonic rarefied gas flow at M = 4 and static pressure p = 0.05 torr is shown. It is presented to illustrate the possibility of adjusting the interference fringes orientation to obtain different fringe shifts with the same flow parameters. Thus an optimal tuning of the instrument is necessary for the study of flows under different conditions. The results obtained here attest a sufficiently good agreement with theoretical data and show the advantages of the two-mirror multiple-beam interference system described here. The density distribution behind a shock layer in a section 0.35 mm distant from the stagnation point of the cylinder is given in a graph. Author (TAB)

N69-22388# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PHOTOELECTRIC METHOD OF MEASURING THE TURBULENCE OF HIGH-TEMPERATURE FLOW

A. M. Trokhan, I. L. Kuznetsov, G. R. Baranova, and Yu. V. Ignatenko Jun. 1968 13 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk), no. 1, 1966 p 112-116

(AD-681642; FTD-MT-24-171-68) Avail: CFSTI CSCL 20/4

A recording method is described which permits determining the amplitude spectrum of the velocity fluctuations of a turbulent flow and to find the mean flow velocity. The investigated section of the flow with tracking particles is projected by means of an optical system onto a flat screen with two parallel slits. In the case of a low-temperature flow this section is illuminated by an intense external source, whereas at a sufficiently high temperature the self-luminescence of the particles can be used. When the image of the luminous particle strikes the slit, a voltage pulse arises at the output of a photomultiplier which is then amplified and discriminated. When the image of the luminous particle strikes the second slit a bright flash appears on the screen of the oscillograph. Since the velocity of various particles in a turbulent flow is dissimilar, the bright flashes arise at various distances from the place of triggering, grouping about a point corresponding to the most powerful transit time of the particles between the slits. Author (TAB)

N69-22397# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Strahlantriebe.

ON THE COMBUSTION AND FLOW PROCESSES IN PREHEATED GAS FLOW WITH HIGH PRESSURE [UEBER DIE BRENN-UND STROEMUNGSVORGAENGE IN AUFGEHEIZTEN GASSTROEMEN HOHEN DRUCKES]

K. D. Emmenthal Sep. 1968 23 p refs In GERMAN; ENGLISH summary

(DLR-FB-68-80) Avail: CFSTI

This paper deals with a test facility for an afterburner working by means of opposed jet flameholders at an elevated pressure level. Under conditions of varied angles of attack of the pressure air fed flameholder nozzles, gas approached temperature, and working pressures blow out velocity dynamic pressure loss and combustion efficiency were determined. Author (ESRO)

N69-22422# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.

FUNDAMENTAL EQUATIONS FOR TWO-PHASE FLOW. PART 1: GENERAL CONSERVATION EQUATIONS [EQUATIONS FONDAMENTALES DES ECOULEMENTS DIPHASIQUES. PREMIERE PARTIE: EQUATIONS GENERALES DE CONSERVATION]

Jean-Marc Delhaye Dec. 1968 101 p refs In FRENCH; ENGLISH summary Presented at the French-Soviet Seminar on Heat Transfer, Grenoble, France, Nov. 1966

(CEA-R-3429-1) Avail: CFSTI

This report deals with the general equations of mass conservation, of momentum conservation, and energy conservation in the case of two-phase flow. Several forms of these equations are presented starting from integral equations which are assumed initially a priori: 1) equations with local instantaneous variables and interfacial conditions, 2) equations with mean instantaneous variables in a cross section and practical applications, 3) equations with a local statistical mean, and equations averaged over a period of time, 4) combination of statistical averages and averages over a cross section, 5) general equations concerning emulsions. Author (ESRO)

N69-22452# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.

ANALYSIS OF A MATHEMATICAL MODEL OF THREE-DIMENSIONAL STEADY INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS

D. W. Martin and D. H. Ferriss Jan. 1969 24 p refs

(NPL-Ma-74) Copyright. Avail: CFSTI

The mathematical properties of a hyperbolic system of five partial differential equations, which extend to three dimensions an earlier model of two-dimensional boundary layer development, are established as a preliminary to numerical solution of the equations. It is shown that the characteristic surfaces and bicharacteristic lines of the system are of special form, local domains of dependence being helical wedges instead of cones. Where a certain parameter of the problem is small, two of the five families of bicharacteristics approach coincidence and an additional equation is required for constructing the solution. A procedure is proposed to meet this situation. Author (ESRO)

N69-22468# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF ASYMPTOTIC INTEGRATION OF LAMINAR BOUNDARY LAYER EQUATIONS

B. I. Reznikov May 1968 31 p refs Transl. into ENGLISH from the Russian

(AD-681620; FTD-MT-24-34-68) Avail: CFSTI CSCL 20/4

After a brief review of the known methods of solving boundary layer problems (numerical, expansions in series, integral), the author presents a brief description of the asymptotic method as an effective analytical tool which makes it possible to reduce the problem of determining the friction and heat transfer to the solution of an ordinary differential equation which includes friction and its derivatives along the longitudinal coordinate. This method is generalized here to the case of the boundary layer in a compressible gas and is applied to calculations of compressible gas flow with arbitrary distributions of velocity past an elliptic cylinder in a wide range of parametric variation, and to the case of flow with gas injection into a boundary layer. The numerical results obtained for

an incompressible liquid are approximated by analytical formulas. An approximate method is presented for the case of arbitrary velocity distribution in the outer flow. A system of nonsimilarity parameters is obtained as the result of the analysis of the asymptotic expansions derived here, which describes the flow along the generatrix of the body. The hypothesis of local similarity is discussed and a qualitative criterion for its application is given. TAB

N69-22513*# Techtran Corp., Glen Burnie, Md.
STRUCTURE OF TURBULENT FLOW IN A TUBE [STRUKTURA TURBULENTNOGO POTOKA V TRUBE]
B. G. Vager et al Washington NASA Mar. 1969 8 p refs Transl. into ENGLISH Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), Jul.–Aug. 1968 p 89–92
(Contract NASw-1695)
(NASA-TT-F-12128) Avail: CFSTI CSCL 20D

The problem of turbulent flow in a straight annular tube is solved. An equation system for turbulent flow, consisting of (1) the motion equation, (2) turbulent energy equation, (3) an expression which relates the turbulence coefficient to a turbulence scale, and (4) an integral equation for determining the turbulence scale, is formulated. The numerical solution for this closed equation system is given and the results are compared with experimental data. Author

N69-22531# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
ON THE PROBLEM OF CLOSURE CONDITIONS IN PARTICULAR FOR VLASOV TURBULENCE
Pitter Gräff Nov. 1968 39 p
(MPI-PAE/PL-7/68) Copyright. Avail: Issuing Activity

In turbulence theory, the equations for the dynamics of statistical quantitites usually form an infinite system. The coupled momentum equations are the best known example. Such relations can also be derived from the n-point distribution functions, which describe the stochastic state of a turbulent medium at every instant. This will be shown for the case of Vlasov turbulence. In order to obtain a solution, it is a common procedure, to terminate such infinite systems of equations by closure-conditions. Often this is considered as an approximation. In the case of Vlasov turbulence it can be shown, that a wide variety of closure conditions, all of which are exactly admissible, exist. Author (ESRO)

N69-22544# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
PROPERTIES OF THE TURBULENCE IN THE TRANSITION REGION OF A ROUND JET
B. M. Nayar, T. E. Siddon, and W. T. Chu Jun. 1969 68 p refs
(Grant AF-AFOSR-672A-67)
(AD-682295; UTIAS-TN-131; AFOSR-68-2880) Avail: CFSTI CSCL 20/4

Experimental data are presented for various properties of the turbulence in the transition region of a low speed air jet (4.5 to 9 diameters downstream). Previous investigations have been restricted to either the mixing region or the region of fully developed flow, the two regions of distinctly different, yet self-preserving turbulence structure. An attempt is made to tie in the present data for the intervening transition region with that of earlier works. The overlap of results is generally quite reasonable. Author (TAB)

N69-22550# Advisory Group for Aerospace Research and Development, Paris (France).
[HYPERSONIC BOUNDARY LAYERS AND FLOW FIELDS] Supplement to Conference Proceedings No. 30
R. Barth, ed. May 1968 53 p refs
(AGARD-CP-30-Suppl) Avail: CFSTI

The discussions are given which followed the presentation of the papers at the fluid dynamics specialists' meeting on hypersonic boundary layers and flow fields held at the Royal Aeronautical Society, in London. It comprises a series of questions raised by the audience and answers provided by the authors.

N69-22567# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
HYPERSONIC INTERACTIONS NEAR SHARP LEADING EDGES Addendum
S. G. Rubin, T. C. Lin, M. Pierucci, and S. Rudman Nov. 1968 8 p refs
(Contract AF 49(368)-1623)
(AD-682292; PIBAL-68-17-Add; AFOSR-68-1368) Avail: CFSTI CSCL 20/4

Implicit and explicit finite difference solutions for the cone and flat plate geometries are obtained for comparison purposes. All of the explicit and implicit solutions, for a given set of stream and initial conditions, were within a maximum deviation of 2% for a lateral mesh size $0.1 \geq \Delta y \geq 0.04$, and a streamwise step size $10^{-6} \leq \Delta x \leq 10^{-4}$. The desirability of a variable mesh size is presented. K.R.G.

N69-22574# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
NONEQUILIBRIUM EFFECTS IN SUPERSONIC-NOZZLE FLOW
J. Gordon Hall and Charles E. Treanor Paris AGARD Dec. 1967 120 p refs
(AGARDograph-124) Avail: CFSTI

The scope is limited to homogeneous gas phase flows and to departures from thermochemical equilibrium arising from collisional relaxation of internal degrees of freedom and chemical reaction, including ionization. Translational-rotational equilibrium is assumed. The first half of the report reviews equilibrium properties of gases at high temperatures and the various nonequilibrium rate processes of interest. The last half discusses nonequilibrium effects occurring in nozzle flow expansions. Diatomic gases and air are emphasized; complex mixtures for propulsion applications are also discussed. Author

N69-22641# Ohio State Univ., Columbus. Dept. of Chemical Engineering.
KNUDSEN AND MOLECULAR DIFFUSION OF GASES IN CAPILLARIES AND POROUS SOLIDS OVER LARGE PRESSURE RANGES Technical Progress Report, 1 Apr. 1968–31 Mar. 1969
Christie J. Geankoplis 22 Nov. 1968 16 p refs
(Contract AT(11-1)-1675)
(COO-1675-5) Avail: CFSTI

Experimental data were recently obtained for diffusion of binary gases in different synthetic porous structures. Solids made and used contained one micropore size and many macropore sizes, several solids where the micropore structure was constant but the macropore radius was varied, and a solid where some of the micropores were blocked off by glass powder particles. Theoretical equations derived for these cases checked the experimental data. The data covered a 1300/1 pressure range which included the Knudsen and most of the transition region. A method was devised to make a plug containing 272 glass capillaries in parallel. Experiments are being made at various pressures to check the theoretical transition region equation. Also, various size capillaries and metal capillaries with rough walls will be used. An analytical solution to the differential equations for diffusion of a three-component gas mixture was obtained for the complete transition region in an open system. NSA

N69-22763# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF THE TRANSITION REGION OF A TURBULENT JET
A. S. Ginevskii Feb. 1968 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhid. Gaza (USSR), no. 3, 1966 p 59-67
(AD-682107; FTD-HT-23-632-67) Avail: CFSTI CSCL 20/4

An approximate calculation method is developed for the transition sections of plane and axisymmetric turbulent jets in a co-moving stream. It is shown why earlier methods, based on differentiation between the initial and final sections, are not applicable in the transition (mixing) region. The velocity profiles obtained by this method in the transition region turn out to be the same for plane and axisymmetric jets, and can be used to calculate the variation of the jet parameters along the stream axis by using the set of integral equations connecting the angular momentum and the energy. Limiting parameters are defined under which the results coincide with the velocity profile of the main section of the turbulent jet. It is concluded that in first approximation the external boundary of the transition layer is straight and is a continuation of the outer boundary of the outer section. The method is then demonstrated to be suitable for a determination of continuous velocity-profile deformation in the transition region. Author (TAB)

N69-22787# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. NEWS. FLUID AND GAS MECHANICS (SELECTED ARTICLES)
V. A. Bashkin, V. I. Alferov, T. I. Okerblom, and A. I. Sarantsev Jul. 1968 36 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhid. Gaza (USSR), no. 5, 1967 p 113-121
(AD-682175; FTD-MT-24-189-68) Avail: CFSTI CSCL 20/4

Contents: Laminar boundary layer on elliptic cylinders of infinite length at arbitrary angle of yaw; Experimental investigation of vortex flow near wings of small aspect ratio and round cones at Mach number 2. TAB

N69-22842# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DETERMINATION BY THE METHOD OF CHARACTERISTICS OF THE STEADY SUPERSONIC FLOW AROUND A PROFILE OR AROUND A BODY OF REVOLUTION, AT A ZERO OR NON-ZERO ANGLE OF ATTACK [CALCUL D'ECOULEMENTS SUPERSONIQUES PERMANENTS AUTOUR DE PROFILS OU DE CORPS DE REVOLUTION, AVEC OU SANS INCIDENCE, PAR LA METODE DES CARACTERISTIQUES]
Pierre Diringer and Pierre Laval 1968 136 p refs In FRENCH, ENGLISH summary
(ONERA-NT-126) Avail: CFSTI

Detailed determination is discussed of the iso-energetic, steady supersonic flow of a gas in chemical equilibrium around a profile or around an axisymmetric body by the method of characteristics. The semi-linearized characteristics method is used in the case of a low angle-of-attack. The programs for a 704--I.B.M. computer cover the flow of perfect and real gases (air) in equilibrium in the case of a zero angle-of-attack and the perfect gases in the case of a non-zero angle-of-attack. The results presented underline the possibilities and the precision of the calculation as well as the diversified applications. Author

N69-22906*# Brown Engineering Co., Inc., Huntsville, Ala.
SLOSH TEST ANALYSIS FOR THE 200-INCH MULTICELL TANK
J. C. Walls and C. E. McCandless 20 Mar. 1969 85 p refs
(Contract NAS8-20073)
(NASA-CR-61268) Avail: CFSTI CSCL 20D

Analytical expressions for liquid natural frequencies, forces, moments, pressures, and surface displacement are determined for a ten-sector circular compartmented tank, geometrically equivalent to the 200-inch multicell tank. Slosh test results for the 200-inch multicell tanks are then compared to these analytically determined values. Author

N69-22907*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOMETRY OF THE GEOMAGNETIC TAIL
Kenneth W. Behannon Apr. 1969 38 p refs Submitted for publication
(NASA-TM-X-63516; X-616-69-148) Avail: CFSTI CSCL 08N

An analysis of magnetic field measurements in the geomagnetic tail from Explorers 33 and 35 was taken. The region and thickness of the depressed field magnitude were measured along with the size of the solar magnetospheric component within that region. An analysis was taken of the magnetotail field divergence from the tail axis, and the average geomagnetic tail aberration was determined. Author

N69-23085*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FORCES AND MOMENTS DUE TO AIR JETS EXHAUSTING PARALLEL TO LARGE FLAT PLATES IN A NEAR VACUUM
Joseph J. Janos and Shenwood Hoffman Washington Apr. 1969 28 p refs
(NASA-TN-D-5147) Avail: CFSTI CSCL 20D

Three flat plates of equal length but with width-length ratios of 0.25, 0.50, and 1.0 were tested. The nozzles used were conical and had nominal exit Mach numbers of 1.0, 3.0, and 5.0. The locations of the nozzles were varied longitudinally and vertically. The plate widths were 48, 96, and 192 throat diameters. The ratios of total pressure to ambient pressure varied from 22×10^6 to 15.5×10^6, and the ratios of jet exit pressure to ambient pressure varied from 11.6×10^6 to 3.2×10^5. The pressure altitude was 312,000 feet (95 km). The impingement forces, moments, and center-of-pressure trends were similar for all three plates. The magnitudes of the impingement parameters were decreased by reducing the plate width or effective plate length, raising the nozzle location, increasing the exit Mach number, or decreasing the jet flow turning angle. For the nozzle positions surveyed, the normal force on the plate was as high as 47.5 percent of the thrust for a nozzle close to the widest plate and as low as 4.8 percent of the thrust for a nozzle relatively high above the narrowest plate. Author

N69-23130# ARO, Inc., Arnold Air Force Station, Tenn.
BINARY BOUNDARY LAYERS ON SHARP CONES IN LOW DENSITY SUPERSONIC AND HYPERSONIC FLOW Final Report, Jun. 1967--Mar. 1968
Arloe W. Mayne, Jr., G. E. Gilley, and Clark H. Lewis AEDC Feb. 1969 44 p refs
(Contract F40600-69-C-0001)
(AD-682294; AEDC-TR-68-275) Avail: CFSTI CSCL 20/4

The effects of surface mass transfer on the flow field around sharp slender cones at zero angle of attack in low density supersonic and hypersonic flow are computed using an iterative inviscid-viscous flow field calculation model. The perfect gas model which is developed considers nonsimilar binary gas boundary layers, viscous interaction, transverse curvature, wall slip, and temperature jump. The inviscid and viscous flow fields are matched using a displacement thickness that includes the effects of surface mass transfer, and the inviscid flow is computed using either the tangent cone theory or the conical shock expansion theory. Calculated effects of helium, argon, carbon dioxide, and air injection on total drag values and surface pressure distributions are compared with experimental data. Author (TAB)

N69-23148*# Commissariat á l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
FUNDAMENTAL EQUATIONS FOR TWO-PHASE FLOW, PART 2: COMPLEMENT AND REMARKS [EQUATIONS FONDAMENTALES DES ECOULEMENTS DIPHASIQUES. DEUXIEME PARTIE: COMPLEMENTS ET REMARQUES]
Jean-Marc Delhaye Dec. 1968 64 p refs In FRENCH; ENGLISH summary
(CEA-R-3429-2) Avail: CFSTI

Certain points arising in the first part of this report concerning general mass-conservation equations for two-phase flow have been completed and clarified. The terms corresponding to the interfacial tension have been introduced into the general equations. The interfacial conditions have thus been generalized. A supplementary step has still to be carried out: it has, in fact, been impossible to take the interfacial tension into account in the case of emulsions. It then appeared interesting to compare this large group of fundamental equations concerning different methods of presenting two-phase flows with those proposed in the literature. Author (ESRO)

N69-23230# Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Reaktorzentrum.
ON THE DYNAMICS OF COMPRESSIBLE SUBSTITUTE FLUIDS FOR ISOTHERMAL TWO-PHASE TWO-COMPONENT FLOWS [ZUR DYNAMIK VON KOMPRESSIBLEN ERSATZFLUIDEN FUER ISOTHERME ZWEI-PHASEN ZWEI-KOMPONENTEN STROEMUNGEN]
H. Eigner 1968 17 p refs In GERMAN Submitted for Publication
(SGAE-RT-16/1968) Avail: CFSTI

A one-dimensional model of a substitute fluid was developed for pipe flow which makes allowance for the effects of friction and gravity. The dynamics involved are formally those to isothermal ideal gases except for the dependence of the acoustic velocity on the gas contents (void fraction) at the pipe inlet. Although the theory is somwehat limited when void fraction $\alpha = 1$, good results were obtained for a case where $\alpha \geq 0.6$. Transl. by K.W.

N69-23273# Oak Ridge National Lab., Tenn.
BUBBLES, DROPS, AND ENTRAINMENT IN MOLTEN SALTS
H. W. Kohn Dec. 1968 21 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2373) Avail: CFSTI

The production and behavior of drops from splashes and bubbles are reviewed and described. Possible application of these phenomena to the MSRE pump bowl is considered. There are three sorts of drops which can contribute to entrainment in the MSRE, jet drops from splashes and from small recirculated bubbles, film drops from the breakup of the film cap of larger bubbles, and crown drops from the breakup of the crown from splash drops. In addition, there might be a considerable direct aerosol formation due to spray from the spray ring. The amount of salt available for entrainment from these sources is much larger than that actually lost from the reactor, hence most of the droplets must be returned somehow to the liquid stream. Jet drops can preferentially remove a surface film from a molten salt surface. This surface microtome effect may well be contributing to the apparent loss of fission products to the gas stream. Author (NSA)

N69-23321# Aeronautical Research Council (Gt. Brit.)
SOME INVESTIGATIONS INTO THE SPANWISE NON-UNIFORMITY OF NOMINALLY TWO-DIMENSIONAL INCOMPRESSIBLE BOUNDARY LAYERS DOWNSTREAM OF GAUZE SCREENS
B. G. de Bray 1969 20 p refs Supersedes ARC-29271; see N68-15198
(ARC-R/M-3578; ARC-29271) Copyright. Avail: CFSTI

This report describes investigations on spanwise non-uniformity in boundary-layer flow at subsonic speeds over a range of experimental conditions, covering particularly the effect of varying number and open-area ratio of screens, type of honeycomb, flow contraction, surface curvature, and downstream position of measuring plane. Regions with laminar and turbulent boundary layers were investigated. Bradshaw's investigations into the effect of open-area ratio are confirmed. The conclusion is drawn that in a boundary-layer tunnel, where spanwise uniformity is essential, at least the two downstream screens should have open-area ratios less than 0.57. The report also recommends the use of a high-quality honeycomb downstream of the screens. Whilst open-area ratios greater than 0.57 are also advisable for new general-purpose tunnels, the report suggests that the cost of changing the screens of existing tunnels is scarcely justifiable economically. Author (ESRO)

N69-23338# Aeronautical Research Council (Gt. Brit.)
THE RESPONSE OF A CONSTANT-PRESSURE TURBULENT BOUNDARY LAYER TO THE SUDDEN APPLICATION OF AN ADVERSE PRESSURE GRADIENT
P. Bradshaw 1969 33 p refs Supersedes NPL-AERO-1219; ARC-28663; see N68-12096
(ARC-R/M-3575; NPL-AERO-1219; ARC-28663) Copyright. Avail: CFSTI

Mean velocity, turbulent intensity and shear stress have been measured in a turbulent boundary layer which passes from a region of constant free-stream velocity U_1 to a region with $U_1 \propto x^{-0.258}$. Further measurements and calculations have been made for a range of initial boundary-layer thicknesses. Author (ESRO)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-21977 Yale Univ., New Haven, Conn.
SOME PROBLEMS PERTAINING TO THE MACROSCOPIC STABILITY OF THE SURFACE OF THE MAGNETOSPHERE
August Charles Buffalano, Jr. (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-11162

The large scale surface dynamics of the dayside of the magnetosphere is investigated by a theoretical study of the Chapman–Ferraro, Ideal Magnetohydrodynamic, and Chew Goldberger Low models of the interaction. The work reported is essentially a phenomenological study to determine the importance of some specific mechanisms which lead to surface instabilities. The important part which the convection of disturbances plays in controlling surface instabilities is shown and leads to the conclusion that, for the models considered at least, the possibility of large amplitude surface disturbances on the dayside of the magnetosphere appears remote. Dissert. Abstr.

N69-22089# Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Meteorological Physics.
RADIATION AND ASSOCIATED OBSERVATIONS MADE ON INDIAN OCEAN CRUISES. 1. CRUISES DURING 1962
E. L. Deacon and J. Stevenson 4 Oct. 1967 23 p refs
(PB-180799; TR-16) Avail: CFSTI CSCL 04B

Measurements of the global radiation (short wave and short wave plus long wave), sea surface and air temperatures, cloud amount and type, and wind speed, made on two cruises in the Indian Ocean, are tabulated, together with the net radiation income from the sea, which was calculated from these measurements. The results are in accord with the daily average values of the sea albedo by TerMarkaryants. Author (USGRDR)

N69-22151*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHOCK METAMORPHISM OF BASALT
Nicholas M. Short Mar. 1969 41 p refs
(NASA-TM-X-63506; X-644-69-117) Avail: CFSTI CSCL 08G

Chemical analysis of the surface veneer at Surveyor lunar touchdown sites indicated the presence of materials of basalt type composition, and it is believed that some of the rocks have been shock metamorphosed by transient pressure waves from meteoritic impacts on the moon. Assuming that future Apollo landings will confirm the fact, a study was initiated in order to establish a method of distinguishing shocked from unshocked basalts for use in determining the origin and history of the specimens which are returned to earth. The crater formed from the Danny Boy event in 1962 was analyzed in detail, since it was found that the distinctive features developed in rocks by shock pressures during meteorite impact are also duplicated by underground nuclear explosions. In studying the crater, the first stages of shock damage, the effect of intense shocks, and the maximum shock damage were determined. A discussion is also included on the methods of measuring shock damage in minerals, such as index of refraction and X-ray diffraction analysis, as well as the asterism technique. It was concluded that the best evidence for intense shock metamorphism in lunar basalts will be pronounced asterism and anomalously low refractive indices in ferromagnesian minerals. A.C.R.

N69-22158*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MASS SPECTROMETRIC TECHNIQUE FOR MEASUREMENT OF ATOMIC OXYGEN IN THE EARTH'S UPPER ATMOSPHERE
Dan N. Harpold and Carl A. Reber Oct. 1968 32 p refs
(NASA-TM-X-63500; X-621-68-407) Avail: CFSTI CSCL 04A

Mass spectrometers carried on the Geoprobe rocket and Explorer 32 satellite were exposed to the atmosphere through knife-edged orifices. At altitudes where there is no significant ambient molecular oxygen (>250km), a determination of ambient atomic oxygen density is made by observing the density of molecular oxygen in the ion source and relating this density to the atomic species. If the recombination efficiency, determined at altitudes greater than 250 km, is independent of time, oxygen density, and other possible effects, the ambient molecular oxygen concentrations at lower altitudes can also be obtained from the measurement. Data obtained from the Geoprobe and Explorer 32 experiments indicate: (1) the efficiency of surface recombination is considerably lower than anticipated; (2) the orificed-chamber technique yields good lower limits to the ambient abundance of atomic oxygen, as there is still uncertainty concerning adsorption or other loss mechanisms on the surfaces; (3) data obtained in the laboratory on surface effects of atomic oxygen at pressures above 0.1 torr apparently cannot be extrapolated to low pressures. Author

N69-22228*# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
GRAVITY AND ATMOSPHERIC PRESSURE SCALING EQUATIONS FOR SMALL EXPLOSION CRATERS IN SAND
S. W. Johnson, J. A. Smith, E. G. Franklin, I. K. Moraski, and D. J. Teal *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 11-25 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 08G

An experimental investigation was conducted to determine the effects of varying gravity and atmospheric pressure on the size of small explosion craters formed in cohesionless sand. The explosives used were commercially available squibs and caps and a linear detonating cord. Gravity was varied by flying the test container in an aircraft through carefully controlled maneuvers aimed to simulate 0.17, 0.38, and 2.5 times terrestrial gravity. Atmospheric pressure was controlled separately by use of a ground based vacuum chamber. The influence of aircraft vibrations, changes in sand density and moisture content, and techniques of measurement were considered and evaluated. It was concluded that both gravity and atmospheric pressure, when varied, will lead to significant changes in crater dimensions. The ratio of diameters is inversely proportional to the ratio of gravities to the power n where n increases as the depth of burst of the explosive increases. The n values are less than 0.16. Crater dimensions are less sensitive to changes in atmospheric pressure in the range from 5×10^{-4} mm Hg to about 300 mm Hg than they are in the range from about 300 to 1000 mm Hg. In the atmospheric pressure range from 300 to 1000 mm Hg, the ratio of diameters is inversely proportional to the ratio of pressures (mm Hg) to the power n where $n = 0.044 \pm 0.004$. Author

N69-22244*# School of Aerospace Medicine, Brooks AFB, Tex.
OBSERVATIONS MADE AT A HIGH-ALTITUDE HIGH-LATITUDE MANNED FACILITY
Fritz M. G. Holmstrom *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 235-251 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 08G

The psychophysiological responses of human subjects, ranging in age from 20 to 40+ years, are recorded and analyzed after their stay of 14 days on Mount Wrangell, Alaska. They received a protracted exposure to the combined stress of altitude, cold, and work. Because the remoteness of the site and an aggressive work program produced a premium on maintaining physical fitness, the health and operational effectiveness of all personnel were observed and recorded. These observations are of practical interest inasmuch as they offer substantial evidence that, contrary to popular belief, it is the older, more mature male and not necessarily the young individual who is better able to adapt effectively to the rigors of life in the Arctic at an altitude of 4160 meters. B.P.

N69-22261*# Volt Information Sciences, Inc., Washington, D. C.
ON THE POSSIBLE INJECTION OF CHARGED PARTICLES INTO THE ZONE OF TRAPPED RADIATION DURING THE MAIN PHASE OF A MAGNETIC STORM
V. P. Shalimov Greenbelt, Md. NASA. Goddard Space Flight Center 8 Feb. 1969 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 941-943
(Contract NAS5-12487)
(NASA-CR-100515; ST-PF-GM-10805) Avail: CFSTI CSCL 04A

The velocity of particle shift across drift shells is computed for a specific structure of the ring current. Some estimates are given of electric field magnitudes and directions. The cases of particles with great and small pitch-angles are considered separately. Possible consequences are evaluated of particle injection from the high-latitude region of quasi-trapped radiation into the outer radiation zone. Author

N69-22263*# Outokumpu Oy, Tapiola (Finland).
ON THE HALF-PLANE MODEL IN DOUBLE DIPOLE ELECTROMAGNETIC PROSPECTING

Sven-Erik Hjelt 1968 41 p refs /ts Acta Polytech. Scan., Phys. including Nucleonics Ser. 60
(PB-180793; APS-PH-60) Avail: CFSTI CSCL 08I

A theoretical analysis of the secondary field is made for systems, where the receiver antenna is situated inside the transmitter loop or very close to it. Starting from Wesley's half plane solution, a simple matrix formulation is found. The expressions include all combinations of antenna geometries and take into account the dip and strike angles of the half plane. Scale model experiments show neglible differences when compared with theoretical calculations. Author (USGRDR)

N69-22285*# Volt Information Sciences, Inc., Washington, D. C.
INTERACTION OF THE INTERPLANETARY MEDIUM WITH THE EARTH'S MAGNETOSPHERE IN A PERIOD OF SOLAR ACTIVITY DECREASE
N. V. Kovalevskiy Greenbelt, Md. NASA. Goddard Space Flight Center 26 Feb. 1969 9 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 9, no. 1, 1969 p 10–13
(Contract NAS5-12487)
(NASA-CR-100826; ST-PF-GM-10811) Avail: CFSTI CSCL 08N

Daily and 3-hourly values (in the plane of the magnetic equator) are computed of the position of the magnetopause, of the bow shock wave, of the thickness of the transitional region near the subsolar point and of the field of magnetopause currents on the Earth's surface. Author

N69-22277*# Volt Information Sciences, Inc., Washington, D. C.
INFRARED RADIATION OF THE UPPER ATMOSPHERE
V. I. Krasovskiy Greenbelt, Md. NASA. Goddard Space Flight Center 17 Feb. 1969 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 943–948
(Contract NAS5-12487)
(ST-AI-ACH-10807) Avail: CFSTI CSCL 04A

This paper discusses extensively the work, proving that no high emission such as 10^3 ergs/cm^2 · sec may take place in the 300–500 km altitude range. To demonstrate this point an analysis is presented of the various forms of energy in the upper atmosphere taking into account the artificial changes and additional amounts of energy released during rocket launchings. Author

N69-22283# Chicago Univ., Ill. Dept. of Geophysical Sciences.
RESEARCH ON LOW LATITUDE THERMAL CIRCULATIONS Final Report
H. L. Kuo Apr. 1968 150 p refs
(Grant Cwb-WBG-71)
(PB-180781) Avail: CFSTI CSCL 04B

The first paper of this report is concerned with the development of a proper boundary layer theory for a general circular vortex, which can be applied both to the symmetric hurricane and to other kinds of vortex motions. The case of a baroclinic vortex with boundary layer flows at the bottom and at the top are also discussed, and the radial flows given by the solution are very similar to the observed radial flows in mature hurricanes. The second paper contained in this report describes a numerical experiment on cumulus convection sustained by a low level source. The third paper describes a laboratory experiment on circular symmetric convection in a rotating fluid. Author (USGRDR)

N69-22291# Stanford Research Inst., Menlo Park, Calif.
HF ATMOSPHERIC RADIO NOISE ON HORIZONTAL DIPOLE ANTENNAS IN THAILAND
George H. Hagn, Rangsit Chindahporn, and John M. Yarborough Jun. 1968 97 p refs
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-681879; Rept-47) Avail: CFSTI CSCL 4/1

The noise power available from the equivalent of lossless half-wave horizontal dipole antennas 23 feet above ground was measured on 2.3, 5.0, and 10.0 MHz at Laem Chabang, Thailand from August 1967 through February 1968. Data were obtained using dipoles oriented magnetically north-south and east-west at the same site where data were being taken with a standard ARN-2 21.75-foot vertical monopole. The noise power available from the dipoles is significantly less than that available from the monopole in the lower part of the HF band, but this difference tends to decrease as frequency increases, becoming negligible at 10.0 MHz at night. The effect of local electrical storms on the average noise power observed with the horizontal antennas was studied. It appears that local electrical storms can cause a significant increase in observed average noise power at 2.3 MHz. The observed increases in average noise power during local storms may be smaller than the actual increases in noise-power flux density at the site because of the limitations of our instrumentation. Author (TAB)

N69-22299*# Volt Information Sciences, Inc., Washington, D. C.
CURRENTS OF QUASI TRAPPED PARTICLES HAVING DISCONTINUITIES ON THE DAY AND NIGHT SIDES OF THE EARTH
V. D. Pletnev et al Greenbelt, Md. NASA. Goddard Space Flight Center 3 Mar. 1969 9 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 103–108
(Contract NAS5-12487)
(NASA-CR-100517; ST-PF-GM-10813) Avail: CFSTI CSCL 04A

The presence in the drift currrent of a collisionless plasma or of a discontinuity is analyzed. An estimate of the possible effects linked with discontinuities is applied to the geomagnetic field. Author

N69-22301*# Volt Information Sciences, Inc., Washington, D. C.
CALCULATION OF SPECTRAL DISTRIBUTION OF X-RADIATION ABSORBED IN THE EARTH'S ATMOSPHERE
S. I. Kozlov et al Greenbelt, Md. NASA. Goddard Space Flight Center 4 Apr. 1969 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 143–149
(Contract NAS5-12487)
(NASA-CR-100567; ST-AI-RAD-10822) Avail: CFSTI CSCL 04A

A calculation is presented of spectral distribution of X-ray energy absorbed in the earth's atmosphere. The initial spectrum of this source's emission corresponds to the law of blackbody emission with a certain temperature T. On the basis of the obtained distribution the spectrum is determined of forming photoelectrons. It is shown that at altitudes above 150 km, the maximum in the distribution of photoelectrons corresponds to approximately 20 Å and is independent of T, which is distinct from the distribution of absorbed energy. Author

N69-22318*# Volt Information Sciences, Inc., Washington, D. C.
ON THE FIBROUS STRUCTURE OF CURRENTS IN THE MAGNETOSPHERE [O VOLOKNISTOY STRUKTURE TOKOV V MAGNITOSFERE]
V. M. Mishin et al Greenbelt, Md. NASA. Goddard Space Flight Center 20 Feb. 1969 11 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6 p 863–868
(Contract NAS5-12487)
(NASA-CR-100548; ST-PF-GM-10808) Avail: CFSTI CSCL 04A

The hypothesis on fibrous small-scale structure of current systems in the Earth's magnetosphere is expressed on the basis of estimates of the magnitude and characteristic dimensions of longitudinal currents in the magnetosphere, closed through the lower ionosphere, and also the data of the coherence of magnetic disturbances in conjugate regions. By way of consequence conclusion is derived on cellular structure of current systems in the ionosphere.

The longitudinal currents are probably equivalent to fluxes of electrons with energies of 1 to 10 KeV and the number of particles to $\approx 10^7 - 10^9$ cm^{-2} sec^{-1} Author

N69-22324*# Volt Information Sciences, Inc., Washington, D. C.
ON THE RATE OF FORMATION OF NEUTRONS UNDER THE ACTION OF COSMIC RADIATION NEAR THE EARTH'S SURFACE
G. V. Gorshkov et al Greenbelt, Md. NASA. Goddard Space Flight Center 9 Apr. 1969 10 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 26, no. 1, 1969 p 27-30
(Contract NAS5-12471)
(NASA-CR-100528; ST-CR-ES-10823) Avail: CFSTI CSCL 04A

An investigation was conducted on the transient effect below the atmosphere–water interface and the latitude and altitude dependences near the ground to determine the background of natural neutrons due to cosmic radiation near the earth's surface. This information is considered for possible applications in prospecting for economic mineral deposits. Instrumentation utilized in the investigation is described. Author

N69-22390*# Volt Information Sciences, Inc., Washington, D. C.
ESTIMATE OF THE RATE OF CHARGED PARTICLE VERTICAL TRANSFER IN THE OUTER PART OF THE IONOSPHERE F2-REGION
A. Muradov et al Greenbelt, Md. NASA. Goddard Space Flight Center 30 Jan. 1968 10 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 8, no. 6, 1968 p 1039–1044
(Contract NAS5-12487)
(NASA-CR-100518; ST-AI-PF-100518) Avail: CFSTI CSCL 04A

A method is presented for the determination of effective rate of charged particle vertical transfer in the ionosphere, taking into account the velocities' vertical gradients. Analytical expressions are obtained for the rate of vertical ionization transfer for various forms of distribution N(h). Numerical estimates are made of the rate of vertical ionization transfer in the upper part of ionosphere's F2-region for the conditions near the settled ones. It is shown, that at altitudes < 350 km, the ambipolar diffusion with velocity of the order of several m/sec, cannot ensure the rate of vertical transfer necessary for the agreement of experimental N(h)-curves with the presently available data on the structural parameters of the upper atmosphere, on solar shortwave radiation and on ionization-recombination processes. Author

N69-22416# Ionospharen-Institut Breissch (West Germany).
ELECTRON DENSITY MEASUREMENTS IN THE D-REGION AND LOWER E-REGION
K. Rawer Paris ESRO Nov. 1967 18 p Presented at the ESRO Summer School, Frascati, Italy, Aug. 1967
(ESRO-SN-79) Avail: CFSTI

In wave propagation theory the normal problem is to compute the field due to a given source when obstacles exist. Here, the question is to solve the inverse problem, i.e. deduce the obstacles from the field measurements. The fundamental equation of wave propagation, even when adapted to the case of a dielectric or conductive medium, is rather difficult to use and approximate solutions are usually preferred. The two chief approximations consist in the use, on the one hand, of the eiconal equation to account for propagation and, on the other hand, in the use of appropriate dispersion formulae (as given by Sellmeier, or Appleton-Lassen, or even Sen and Wyller) to describe the medium. On the experimental side, measurements are based on the Doppler effect (either direct in the case of a single frequency, or differential in the case of two frequencies) or on the Faraday rotation effect. Author (ESRO)

N69-22481# California Univ., Berkeley. Hydraulic Engineering Lab.
EXTENDED APPLICATION OF A SINGLE HOT-FILM PROBE FOR THE MEASUREMENT OF TURBULENCE IN A FLOW WITHOUT MEAN VELOCITY
M. M. Das Dec. 1968 159 p refs
(Contract DACW 72-67-C-0015)
(AD-681923; HEL-3-20) Avail: CFSTI CSCL 08/3

The linear wave theory shows that in relatively deep water outside the breaker zone the motion near the bed due to surface waves is oscillatory. This oscillatory motion establishes an oscillatory wave boundary layer, which can become turbulent under certain wave conditions and bed roughness conditions. The hydrodynamic effect of the turbulent boundary layer has been studied previously in connection with bed load transport under such conditions. The purpose of the study is to investigate the characteristics of the structure of turbulence above the turbulent boundary layer due to an oscillating bed, with a view to predicting suspended load distribution in such a flow field. The method of application of the single hot-film probe to measure the vertical component of turbulent fluctuations in the flow field above the oscillating bottom with no mean motion was described and the results of analysis of the preliminary measurements made by using this method are also presented. Author (TAB)

N69-22498# Meteorological Office (Gt. Brit.)
ABSOLUTE CALIBRATIONS AT WAVELENGTHS BETWEEN 1350 AND 4000 Å
D. E. Miller and P. J. L. Wildman *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 205–212 (See N69-22476 11-30)
Avail: CFSTI

When measuring atmospheric constituents by their attenuation of solar UV it is necessary both to know the solar intensity at the wavelength concerned, and to be able to calibrate detectors absolutely. Sensors for ozone detection working between 2400 Å and 3650 Å may be compared directly with a secondary standard calibrated against a thermopile at the National Physical Laboratory. For molecular oxygen, detectors must be calibrated at between 1400 Å and 1500 Å, for which NPL do not as yet have an intensity measurement. A wavelength shifting phosphor is therefore employed in a laboratory system, and this is compared at wavelengths greater than 2400 Å with the NPL secondary standard. Ionisation chambers calibrated in this way have been checked in an independent system based on the quantum efficiency of nitric oxide (NO) at 1216 Å, and agreement of about ±15 per cent found. Experience with the Meteorological Office system has suggested that it is advisable that the whole of the calibrated UV beam from the monochromator system should enter the detector under calibration due to the non-uniformity of the beam produced and its changes with wavelength. This condition was satisfied with the NO based system. Author (ESRO)

N69-22518# Ohio State Univ., Columbus. Dept. of Geodetic Science.
DENSITY DISTRIBUTIONS FOR THE EQUIPOTENTIAL ELLIPSOID
Helmut Moritz Oct. 1968 62 p refs
(Contract AF 19(628)-5701)
(AD-681853; OGS-115; AFCRL-68-0563; SR-24) Avail: CFSTI CSCL 8/5

Part I deals with a general method of finding regular mass distributions for the equipotential ellipsoid; the method is illustrated by a simple model consisting of a homogeneous core and a nearly homogeneous mantle. In Part II continuous density models using finite closed polynomials are investigated with a view to finding the simplest expressions that are consistent with the general trend of the distribution of density as represented by Bullards density

law. The subjects of Part III are special topics such as potential and gravity inside the earth, some unsolved problems being pointed out. Author (TAB)

N69-22578# Kansas Univ., Lawrence. Center for Research in Engineering Science.
SURFACE SCATTERING IN OCEAN ROUGHNESS AND SEA ICE STUDIES
Albert W. Biggs *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 8 p refs (See N69-22576 11-07)
Avail: CFSTI

Scattering from rough surfaces is reviewed in terms of analytical and experimental results. The angle of incidence and wavelength of the incident electromagnetic wave, polarization of the wave with respect to the surface, effective dielectric constant and conductivity at the surface, and the surface roughness spectrum relative to wavelength are parameters introduced in descriptions of backscatter variations. The rough surfaces include ocean roughness in the form of sea states generated by different wind speeds and sea ice in the Arctic regions. The sea states were observed with radar scatter techniques over ocean sectors offshore from Bermuda, Newfoundland, and Iceland. Sea ice, separated into polar (several years old) and winter (less than one season old) ice, was observed in the Beaufort Sea near Point Barrow, Alaska. Measurements of the variations of the radar scattering coefficient with the above parameters are made with the radar scatterometer. Correlations of the scattered signal with the terrain are achieved with ground truth observations of terrain characteristics. Author

N69-22580# Marconi Co., Ltd., Great Baddow (England). Research Labs.
SOME FEATURES OF HF BACKSCATTER IONOGRAMS
L. W. Barclay *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

On several days the backscattered returns from swept-frequency fixed-azimuth HF pulse transmissions were recorded on P'f ionograms at one minute intervals. The rapid sequence allows an examination of changes of detail in the backscatter signals. Usually the returns indicated have a range spread of little more than a pulse width. The predominant feature is a return with a range which increases with increasing frequency; this is ascribed to focusing of the minimum time paths via the F-region. Other returns are observed at greater ranges and these often have a range which is approximately independent of frequency. It is suggested that these are due to travelling disturbances in the ionosphere. Detailed examination has not indicated any preferred ranges for backscatter returns and it is concluded that, for a path which traverses land without outstanding profile features, the ionospheric variations are more important than ground scatter variations in determining the ranges at which returns are observed. Author

N69-22583# Defence Research Telecommunications Establishment, Ottawa (Ontario). Radio Physics Lab.
INTERFERENCE PATTERNS IN HF SIGNALS BACKSCATTERED FROM OCEAN WAVES
D. B. Muldrew *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

Signals backscattered from the North Atlantic Ocean were occasionally observed at Ottawa from 1957 to 1964 at frequencies in the range from 25 to 40 MHz using an oblique-incidence ionospheric sounder. Enhancement of the backscatter signal by skip-distance or time-delay focusing is evident on most of the ionogram records containing backscatter signals. In addition, patterns consisting of up to six parallel ridges appear. It is thought that these patterns are caused by interference of radio waves backscattered from spatially coherent waves on the ocean surface at distances of a few thousand kilometers from the transmitter. The frequency separation of the interference ridges indicates that the ocean-wave components which are responsible for the ridges have a wavelength of about 50 to 200 m; such waves can occur in ocean swell generated by gales on the ocean. From the orientation of the ridges on the ionogram, the change in wavelength, with distance from the transmitter, of the ocean swell responsible for the ridges can be deduced. Author

N69-22587# Centre National d'Etudes des Telecommunications, Saclay (France). Div. des Previsions Ionospheriques.
SHORT NOTE ON ECHOES TWICE REFLECTED BY THE F REGION OBSERVED AT DJIBOUTI [COURTE NOTE SUR LES ECHO 2 x F DIFFUS OBSERVES A DJIBOUTI]
A. M. Bourdila and J. Odoux *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 6 p refs In FRENCH (See N69-22576 11-07)
Avail: CFSTI

A statistical study of diffuse tracking for the year 1964 is presented for the purpose of determining the nature of the phenomenon. The percentages of its appearance are investigated as a function of the hour and of the month. It appears that the phenomenon cannot be attributed either to a technical cause or to the solar reflection alone. Ionospheric profiles indicate that the appearance of twice reflected echoes by the F region can be linked to the presence of an ionospheric gradient above the sounding station. Retroreflection by the sea and Doppler effects are also mentioned. Transl. by P.A.B.

N69-22588# Johannes-Gutenberg-Universitat, Mainz (West Germany). Meteorologisches Inst.
SCATTERING OF ELECTROMAGNETIC RADIATION BY PARTICULATE SUSPENSIONS IN THE ATMOSPHERE
Kurt Bullrich *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 22 p refs (See N69-22576 11-07)
Avail: CFSTI

The scattering parameters in the turbid atmosphere are surveyed. In particular, the role of the aerosol particles are described, as to their size distribution, structure, and refractive index. Atmospheric aerosol behavior and the scattering of higher orders are also discussed. Author

N69-22589# Norwegian Defence Research Establishment, Kjeller.
SCATTERING OF RADIO WAVES FROM REGULAR AND IRREGULAR TIME VARYING REFRACTIVE INDEX STRUCTURES IN THE TROPOSPHERE
Dag T Gjessing *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 18 p refs (See N69-22576 11-07)
Avail: CFSTI

The problems related to tropospheric radio scatter propagation are reviewed. A unified treatment of the phenomena encountered is given in the sense that scattering from turbulent irregularities and scattering from layers are not treated as separate phenomena using the two "classical" sets of mathematical tools. Starting from first principles, it is shown that any atmospheric structure, random (turbulent) or ordered (layered), can be expressed in general terms in the form of a three-dimensional refractive index spectrum. When investigating the characteristic properties of the scattered radio wave (angular power spectrum, bandwidth, frequency and space diversity properties, antenna-to-medium coupling loss, etc), the calculations are based on this general three-dimensional refractive index spectrum. Author

N69-22594# Federal German Post Office, Darmstadt (West Germany). Research Inst.
THE THEORY OF TROPOSPHERIC SCATTERING IN THE LIGHT OF NEW PROPAGATION MEASUREMENTS

L. Fehlhaber *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 6 p refs (See N69-22576 11-07)
Avail: CFSTI

A theory is presented to show that measurements of the electromagnetic field performed at the receiving site of a scatter link allow conclusions to be drawn concerning the mechanism of propagation. Previous measurements yielded the space-time correlation function of the field, its scale lengths, horizontal and vertical drift velocities and fluctuation velocity, and it is shown that the corresponding structure of the troposphere can be deduced from these results. In addition, the problem of obtaining the height dependence of the inhomogeneities of refractivity obtained from routine radiosonde data is discussed, and a model of the troposphere, deduced from these data, is given. Author

N69-22595# Hamburg Univ. (West Germany).
MICROWAVE PROPAGATION INFLUENCED BY INTERNAL GRAVITY WAVES
Gerda Fengler and Gerd Stilke *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 10 p refs (See N69-22576 11-07)
Avail: CFSTI

Topics related to the influence of a moving rippled layer on the fading characteristics of VHF signals on transhorizon links are discussed. These include: (1) measurements of micropressure variations on the ground and the analysis of these data to deduce the existence of gravity waves in the lower troposphere; (2) corresponding measurements of electromagnetic field strength (92.4 MHz) fadings; and (3) synthesis of both parameters, resulting in the phenomenon of reflection from moving wavy boundary surfaces. Author

N69-22597# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
ELECTROMAGNETIC SCATTERING FROM AIR CURRENTS
H. N. Kritikos *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 6 p refs (See N69-22576 11-07)
Avail: CFSTI

The scattering of a plane monochromatic electromagnetic wave incident on an air current was studied by considering a jet stream in a homogeneous dielectric fluid to be its idealized model. Starting with a differential equation for the reflection coefficient a solution was obtained for a parabolic velocity transition. The results show that, to a first order in β, reflections can only take place at forward scattering, large angles of incidence and transitions which are of the order of a wavelength. Reflections at normal incidence, i.e., backscatter, are of one order of magnitude in β below those of oblique incidence. For wind shears of 0.1 sec^{-1} measured over a distance of 100 m, an angle of incidence of 85° and a frequency of 50 MHz, the reflection coefficient is of the order of $R = 10^{-10}$ Author

N69-22598# Air Force Cambridge Research Labs., Bedford, Mass.
TROPOSPHERIC SCATTER PROPAGATION AT 16 G-Hz OVER A 500 km PATH
Uve H. W. Lammers, Edward E. Altschuler, and John W. B. Day (Defense Res. Telecommun. Estab., Ottawa) *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 10 p refs (See N69-22576 11-07)
Avail: CFSTI

A forward scatter experiment was conducted to study tropospheric structure with high resolution antennas. Synchronous, computer controlled, beam swinging techniques rendered two dimensional cuts of the troposphere covering up to 2000 km^2 in a 10 minute raster scan. High stability CW signals were used for Doppler and spectral studies within the 5 km^3 troposcatter volume. Author

N69-22601# Saskatchewan Univ., Saskatoon. Inst. of Space and Atmospheric Studies.
RADIO WAVE SCATTERING FROM THE IONOSPHERIC D-REGION
J. B. Gregory *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 15 p refs (See N69-22576 11-07)
Avail: CFSTI

Partial reflections and scattering of radio waves vertically incident upon the lower ionosphere are reviewed. Present knowledge is summarized, in relation to heights of occurrence of partial reflections and their seasonal and diurnal variation, thicknesses of scattering regions, height profiles of scatter strength and their variations, and angular spectra of reflected waves. Theoretical treatments of perturbations in electron density and collision frequency are examined. The outstanding lack of knowledge concerns processes in the fluid atmosphere which cause these perturbations. Existing radio wave theories are essentially descriptive, and the application of more complex formulations requires a corresponding advance in physical understanding. The relation of vertical backscattering and oblique forward scattering is discussed. Applications of scattering to the determination of electron densities below 100 km, to the measurement of winds above 65 km, and to detection of particle influx are discussed. New developments in relation to the influence of atmospheric circulation on the aeronomy of the lower ionosphere are outlined. Author

N69-22602# Auroral Observatory, Tromso (Norway).
DRIFT MEASUREMENTS BY USE OF D-REGION PARTIAL REFLECTIONS
Arne Haug and Olan Holt (Norweg. Defence Res. Estab.) *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 8 p refs (See N69-22576 11-07)
Avail: CFSTI

Preliminary results are presented from a continuing experiment, in which an established method of measurement is applied to D region partial reflections to ascertain the feasibility of such a technique. Partially reflected waves at 2.75 MHz were received on four loop aerials, the spacing between which was of the order of one wavelength. The experimental equipment is briefly described, including the analog computer used in correlation analysis of the fadings, which were recorded on four channel magnetic tape. Drift measurements were made down to 60 km, but most of the reflections were measured from the region 70–100 km. Height profiles of electron density were measured simultaneously. Due to the preliminary nature of the results, no conclusions were drawn concerning seasonal variation in the region's winds or other changing factors. Author

N69-22604# Royal Radar Establishment, Malvern (England).
INCOHERENT SCATTER OBSERVATIONS OF THE E-REGION
G. N. Taylor *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

The method of measuring profiles of electron concentration, N_e, versus height in the lower ionosphere with a pulsed incoherent scatter radar is described. The lowest measurable N_e is determined partly by equipment sensitivity and partly by the plasma Debye length becoming comparable with the radar wavelength. Incoherent scatter yields good E region profiles in conditions which defeat the ionosonde, for example, at nighttime during blanketing E_s or high absorption, and when N_e is not increasing monotonically with height. It also gives much better temporal coverage than sounding rockets. Some typical mid-latitude summer profiles for both nighttime and daytime are presented. Plots of the heights of well defined peaks against time illustrate the relative stability of the normal- and sporadic-E peaks, and the large number of abnormal propagation modes that can exist for short periods. Author

N69-22606# Western Ontario Univ., London. Centre for Radio Science.
AURORAL SCATTER
P. A. Forsyth *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 10 p refs (See N69-22605 11-07)
Avail: CFSTI

The evidence regarding the nature of radio aurora, particularly that relating to the scattering mechanism, is reviewed. Much evidence is found which supports the hypothesis that the radio waves are scattered from electron density gradients produced by propagating ion-acoustic waves in the auroral ionization. Such waves could be generated by the auroral electrojet. Nevertheless, there is another large body of evidence which cannot be explained by the existence of ion-acoustic waves. It is concluded that this evidence relates to occasions on which the radio waves are weakly scattered from electron density gradients randomly distributed throughout the auroral ionization. It is possible also that strong scattering sometimes occurs for radio frequencies near the bottom of the VHF band. Author

N69-22607# Norwegian Defence Research Establishment, Kjeller.
A NOTE ON A PARTICULAR TYPE OF SCATTERING ECHOES OBSERVED AT HIGH LATITUDES
Kristen Folkestad *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 6 p refs (See N69-22605 11-07) (Contract AF 61(052)-835)
Avail: CFSTI

A particular group of backscatter traces recorded in swept frequency oblique soundings at high latitudes is discussed. Characteristic echo properties are displayed. Results of attempts to interpret the measured returns are given. The explanation offered is in terms of aspect sensitive scattering from irregularities located in spatially limited regions of enhanced ionization density to the north of the sounding site. Author

N69-22608# General Electric Co., Syracuse, N. Y.
FIELD ALIGNED IONIZATION SCATTER GEOMETRY
George H. Millman *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 16 p refs (See N69-22605 11-07)
Avail: CFSTI

An evaluation is made of theoretical and graphical methods for calculating the orientation of the magnetic field for backscatter reflections, and the locus of points on the earth's surface for the reception of the forward scatter mode. The theoretical methods which are considered involve the assumption that the earth's magnetic field can be approximated by the field of a magnetic dipole located at the earth's center, by the combination of a dipole field and an irregular field, i.e., a series of spherical harmonics. The graphical technique utilizes ground-observed magnetic data scaled from isomagnetic maps. Computations for both the backscatter and forward scatter modes of propagation are presented for two locations in the Northern Hemisphere. Author

N69-22609# Environmental Science Services Administration, Boulder, Colo. ESSA Research Labs.
REVIEW OF VHF FORWARD SCATTER
Richard C. Kirby *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 12 p refs (See N69-22605 11-07)
Avail: CFSTI

This review of VHF forward scatter presents mainly a *description* of the *continuous propagation* observed at oblique incidence throughout the world, in the frequency range 25 to 110 MHz, scattered from irregularities in electron density in the 70–80 km height range, and from meteoric ionization. Observations have been largely made over 1000 to 2000 km path lengths in the northern and southern hemispheres and near the equator, using pulsed and continuous wave transmissions. Some attention is drawn to extra modes of propagation, primarily from the E-region at low latitudes and aurora at high latitudes. Absorption effects, particularly in connection with polar cap absorption events, are mentioned. Author

N69-22611# Michigan State Univ., East Lansing.
CONTROLLABILITY ASPECTS OF SCATTER PROPAGATION OF RADIO WAVES
M. Z. von Krzywoblocki *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 15 p refs (See N69-22605 11-07)
Avail: CFSTI

The statistical theory of the locally isotropic turbulence in the Kolmogorov formulation and the main equations of electromagnetic wave scattering due to turbulence are discussed. Electromagnetic wave scattering in a plasma is treated; the main aspects of the mathematical formalism are presented with relation to transverse wave scattering. Scatter propagation is discussed for very high, low, and very low frequencies. An attempt is made to propose a formalism, mathematically stronger than those currently available, for selecting optimum working frequencies for various kinds of scatter propagation. The fundamentals of the optimization theory are reviewed, emphasizing the control functions and the functional which must be optimized. A scheme for scatter propagation controllability is then outlined, based on solving a given Maxwell system. The scattering cross section, in the form of an integral, is expressed as the minimum. The chosen control functions are varied so that the solution of the system furnishes the sought optimum of the integral. In this way, the optimum values of the parametric variables of the sending station are determined, and the scatter propagation of the radio waves may be controlled. P.A.B.

N69-22612# Instituto Geofisico del Peru, Huancayo.
VHF IONOSPHERIC SCATTER PROPAGATION VIA THE EQUATORIAL ELECTROJET
Carlos A. Romero (Jicamarca Radar Obs.), Alberto A. Giesecke, and Oscar Perez (Peruvian Army) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 20 p refs Supported in part by ESSA
Avail: CFSTI

Results are presented of a statistical analysis of VHF ionospheric forward scatter signals propagated via the equatorial electrojet. Continuous data were obtained from November 1966 through June 1967 during moderate sunspot activity. Comparison of these data with those obtained during the International Geophysical Year shows that the influence of the solar cycle is very small. During the period of this study, as in the IGY, the signal levels propagated by forward scatter at the magnetic equator are considerably higher than those for similar paths at temperate latitudes. The daily variation of signal intensity attains its maximum level during daytime hours, associated with minimum fading rate. A secondary maximum occurs during the nighttime hours, associated with a higher fading rate. The relative minima in the daily variation occur at times of reversal in the electrojet flow direction. The effects on the VHF scatter signals of magnetic storms, sudden ionospheric disturbances, and of the total solar eclipse of November 12, 1966, are also studied. Author

N69-22613# Air Force Cambridge Research Labs., Bedford, Mass.
MICROWAVE SCATTERING FROM SPHERICAL ELECTRON CLOUDS
N. W. Rosenberg, M. M. Klein, and G. Anderson (Harvard Coll. Obs.) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 10 p refs (See N69-22605 11-07)
Avail: CFSTI

The scattering of radio waves by a spherical electron cloud with a Gaussian distribution of electron density has been treated

numerically by ray optics methods. In the case of no magnetic field, it is found that a hard or highly overdense sphere may be replaced by a conducting sphere of radius equal to the critical radius. This approximation is inaccurate for a soft or slightly overdense sphere. It is also found that, in forward scatter, all spheres have essentially the same cross section. The effect of a magnetic field is found to be negligible in forward scattering and effective in backscatter only for soft spheres. The orientation of the field is similarly important in backscatter for soft spheres only. The extraordinary ray yields a cross section generally typical of a hard sphere, provided the gyromagnetic ratio is not too small. Author

N69-22615# Stanford Research Inst., Menlo Park, Calif.
A REVIEW OF VHF TRANSEQUATORIAL PROPAGATION
D. L. Nielson *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 18 p refs (See N69-22605 11-07)
Avail: CFSTI

An examination is made of both published and unpublished literature concerning VHF propagation over transequatorial paths. At least two classes of propagation appear to exist; their demarcation is given in terms of the possible reflection mechanism, the signal characteristics, and the distance of the terminals from the magnetic equator. Propagation of one class uses refraction from the horizontal gradients of electron density that are regular diurnal characteristics of the equatorial ionosphere. A second class is required to explain the propagation of frequencies above about 80 MHz. This class is characteristic of 400 to 6000 km paths and is due to both normal refraction and a low-loss reflection mechanism that is not yet completely defined. Signal characteristics for this second class of propagation are documented, and three possible mechanisms are discussed. Author

N69-22616# Stanford Research Inst., Menlo Park, Calif.
THE IMPORTANCE OF HORIZONTAL F-REGION DRIFTS TO TRANSEQUATORIAL VHF PROPAGATION
D. L. Nielson *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 6 p refs (See N69-22605 11-07)
Avail: CFSTI

Evidence is offered for oblique reflection from a moving F-region irregularity, at frequencies as high as 90MHz. The velocity of the irregularity is 150 ms^{-1} in an east-west direction. Evidence is also presented showing the relative sensitivity of VHF propagation on a 5000 km transequatorial path to magnetic latitudinal and longitudinal variations. Author

N69-22617# Paris Univ. (France). Lab. de Physique de l'Exosphere.
STUDY OF TRANSEQUATORIAL PROPAGATION OUTSIDE A LARGE PATH OF OCCURRING PERIODS OF F-REGION DRIFT [ETUDE D'UNE PROPAGATION TRANSEQUATORIALE EN DEHORS DU GRAND CERCLE EN PERIODE D'OCCURRENCE DE F DIFFUS]
M. Crochet et P. Broche *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 10 p refs In FRENCH (See N69-22605 11-07)
Avail: CFSTI

A type of propagation over a long distance was studied between France and Tahiti. Evidence was found for a very stable propagation outside the great circle. Its origin, determined by measures of signal transit times and arrival directions, was localized in the region of the magnetic equator. The following possible mechanisms of production of these signals are considered: (1) refraction by a lateral gradient; (2) diffusion to the ocean surface; (3) diffusion in the F region associated with equatorial spread F. Transl. by P.A.B.

N69-22618# Syracuse Univ. Research Corp., N. Y.
RAY TRACING OVER A TRANSEQUATORIAL PATH
N. C. Gerson *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 24 p refs (See N69-22605 11-07)
Avail: CFSTI

Ray-tracing procedures including the magnetic field were employed to clarify the mechanism of transequatorial propagation. The basic data employed were 41 MHz backscatter soundings and vertical incidence observations converted into electron density versus true height profiles. Qualitative but not quantitative agreement between transequatorial (TE) observations and TE calculated ray paths was found. Author

N69-22619*# Environmental Science Services Administration, Boulder, Colo. Aeronomy Lab.
TRANSEQUATORIAL PROPAGATION IMPLICATIONS OF EQUATORIAL VERTICAL DRIFT MEASUREMENTS
Robert Cohen and J. P. McClure (Jicamarca Radar Obs.) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 16 p refs (See N69-22605 11-07)
(NASA Order R-06-012-008)
Avail: CFSTI CSCL 04A

Applying a time-dependent theory of the transequatorial ionization distribution and measuring vertical drifts of the f-region plasma at the magnetic equator, help to clarify the transequatorial propagation phenomena. The status of theory and the status of experiment are discussed, along with the interrelation of theory and experiment, and a program of investigation is recommended involving radar observations from satellites and from the ground, radio propagation studies, airglow observations, ray-tracing, and theoretical analysis. Author

N69-22620# Environmental Science Services Administration, Boulder, Colo. Aeronomy Lab.
F-REGION SCATTER
Robert Cohen *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 12 p refs (See N69-22605 11-07)
Avail: CFSTI

Experience in f-region propagation attributable to scattering is reviewed. The results of forward scatter and backscatter diagnostic studies of f-region irregularities are summarized. These results are related to their consequences and utility for f-region scatter propagation. The ionospheric observations of the waveguide and whispering-gallery modes of propagation are summarized. Author

N69-22621# Environmental Science Services Administration, Boulder, Colo. Space Disturbances Laboratory
RADIO-DOPPLER OBSERVATIONS OF THE IONOSPHERE NEAR THE MAGNETIC EQUATOR
Kenneth Davies and Norman J. F. Chang *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 6 p refs (See N69-22605 11-07)
Avail: CFSTI

Radio observations of the ionosphere near the magnetic equator exhibit echoes with marked frequency scatter during evening hours. The mean frequency shift is predominantly positive but decays with time. A model is presented to explain this phenomenon in terms of asymmetric atmospheric waves propagating from west to east with velocities in the range 100 to 150 m/s. Statistical evidence is presented which shows that the duration of the echoes peaks around 60 min, the average period between the onset of successive echoes is also about 60 min and the occurrence of these echoes exhibits a pronounced minimum in the summer. Author

N69-22623# Norwegian Defence Research Establishment, Kjeller.
SATELLITE SCINTILLATION AT HIGH ALTITUDES
Jon Frihagen *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 3 p refs (See N69-22605 11-07)
Avail: CFSTI

Results are presented of a study of satellite scintillation on 40 MHz as observed from a station. There is a polar region of the ionosphere that gives rise to scintillation which has no observed poleward boundary, but has a southern boundary during magnetically quiet days. A model in which field-aligned irregularities are produced by soft particle precipitation is considered. Fluxes of the order of 10^{12} particles per (m^2 sec KeV) at 1 KeV were observed to reach to high latitudes and they show large and rapid variation. Author

N69-22624# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunications Sciences.
HF RADAR SIGNATURES OF TRAVELING IONOSPHERIC IRREGULARITIES: 3D RAY-TRACING SIMULATION
T. M. Georges and Judith J. Stephenson *In* AGARD Scatter Propagation on Radio Waves, Pt. 2 Aug. 1968 16 p refs (See N69-22605 11-07)
Avail: CFSTI

A technique is described for simulating a multitude of ground-backscatter displays using information supplied by three-dimensional computer ray tracing. Model ionospheres containing realistic wavelike traveling disturbances are used to produce representative displays and to correct some misconceptions about the interpretation of backscatter signatures. Author

N69-22625# General Electric Co., Syracuse, N. Y. Electronics Lab.
NATURE OF F-REGION IRREGULARITIES INFERRED FROM OBLIQUE REFLECTION MEASUREMENTS
L. C. Humphrey, C. R. Roberts, and R. Mather (RADC) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 9 p refs (See N69-22605 11-07)
(Contract AF 30(602)-3946)
Avail: CFSTI

The data from two types of radiowave measurements are described which reveal the nature of both long-term and short-term irregularities, including traveling ionospheric disturbances. These measurements are the fading characteristics themselves, and the measurement of apparent azimuth of arrival on the long-distance path. The strength, curvature, and extent of the irregularities are deduced from the measurements. Author

N69-22626# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany).
BACKSCATTER OBSERVATIONS FROM DISTANT FIELD-ALIGNED IRREGULARITIES
H. Kopka and H. G. Moeller (Uppsala Ionospheric Obs.) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 14 p refs (See N69-22605 11-07)
Avail: CFSTI

Reflections from distant field-aligned irregularities were observed by backscatter observations and correlation with the occurrence of spread-F. The relative magnitude of backscattered energy was calculated as a function of the relative electron density variation and the distance of the scattering irregularities. Comparison of topside spread-F observations and bottomside backscatter observations was made to find out whether the frequency of occurrence of spread-F is higher on the bottomside or on the topside of the ionosphere. Author

N69-22627*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
RESEARCH ON FIELD-ALIGNED PROPAGATION OF HG RADIOWAVES USING ALOUETTE 2 TOPSIDE SOUNDER DATA AND DIGITAL RAY-TRACING TECHNIQUES
Jayaram Ramasastry, Edward J. Walsh, and John R. Herman (Lowell Technol. Inst. Res. Found.) *In* AGARD Scatter Propagation of Radio Waves, Pt. 2 Aug. 1968 28 p refs (See N69-22605 11-07)
Avail: CFSTI CSCL 17B

Guidance of HF radiowaves along field-aligned paths using the top-side sounder data from the Alouette 2 satellite is studied. More than 100,000 Alouette 2 ionograms were used and an unusually high percentage of occurrence of conjugate echoes were observed in the data of some equatorial stations. Three interesting types of ionograms containing conjugate echo traces are presented. A self-consistent explanation based on the assumption of multiple reflections between conjugate points of the field line passing through the satellite is presented. The results of the digital ray-tracing study of the guidance of HF radiowaves along field-aligned ionization irregularities in the magnetosphere of the earth is given. Various computer results are shown to illustrate the mechanism of guidance of radiowaves. Time-delay and trapping characteristics of the three types of conjugate echoes that are frequently observed in the Alouette 2 topside sounder records are simulated using the ray-tracing methods. Some of the optimum conditions for guidance of electromagnetic waves along a magnetic field line are discussed. Author

N69-22786# Weapons Research Establishment, Salisbury (Australia).
A REVIEW OF THE AERO-HIGH PROGRAM OF EXPERIMENTS IN THE LOWER THERMOSPHERE
L. M. Sheppard Dec. 1968 14 p refs
(WRE-TN-HSA-140) Avail: CFSTI

Since June 1964, five Aero-High sounding rockets have released chemicals for seeding experiments between 80 km and 165 km altitude. The main aims of the experimental program are to investigate the structure of the atmosphere between 100 km and 200 km altitude, and to investigate chemical reactions in the very low pressure, wall-free environment of the upper atmosphere. A review of the results achieved and the future plans are given. All rockets carried one or more chemical seeding experiments. Contaminants such as nitrogen dioxide, aluminium monoxide and lithium were used to give information on atmospheric wind, turbulence, diffusion, density, temperature and composition. A description of a density gauge experiment is given. Author

N69-22805*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROTON ENTRY INTO THE MAGNETOSPHERE ON 28 MAY 1967
D. J. Williams and C. O. Bostrom (Applied Physic Lab., Johns Hopkins Univ.) Apr. 1969 20 p refs Submitted for publication Prepared by APL
(NASA Order R-21-009-004(021); Contract NOw-62-0604-c)
(NASA-TM-X-63514; X-612-69-141) Avail: CFSTI CSCL 20H

Low energy proton observations over the polar cap and in the interplanetary and magnetosheath regions are compared during May 26, 1967. The results indicate that at this time the entry of low energy solar protons into the magnetosphere was controlled by a diffusion process. It also appears that the protons had access to the entire figure-8 current pattern in the geomagnetic tail and diffused into the two approximately circular cylinders containing the field lines from the northern and southern polar caps. A first approximation value of 10^{15} to $10^{16} cm^2 sec^{-1}$ is obtained for the radial diffusion coefficient, D_{rr}, in the tail. No value can be derived for the diffusion coefficient along the field line, D_{zz}

with the present data. Consequently, in the present case, only a rough upper limit of $L^C \leq (420 \text{ to } 2400)R_E$ is obtained for the distance to the region where low energy protons are diffused into the tail. Author

N69-22873# Wisconsin Univ., Madison. Engineering Experiment Station.
HEAT DISSIPATION AND INDUCED CIRCULATIONS FROM CONDENSER COOLING WATER DISCHARGES INTO LAKE MONONA
John A. Hoopes, Robert W. Zeller, and Gerard A. Rohlich Feb. 1968 213 p refs
(Grant PHS-133-5371)
(PB-180376; Rept-35) Avail: CFSTI CSCL 13B

A study was undertaken at the University of Wisconsin to investigate the effects of heated water discharges on a lake environment. In the first phase of this study, the mechanisms of heat dissipation and the velocity patterns resulting from the heated water discharges were investigated by (1) undertaking field surveys of the temperature and velocity distributions in the lake at different times of the year, and (2) developing mathematical models for the prediction of the observed temperature and circulation patterns. Throughout a year twenty-four surveys of the velocity and temperature patterns in the lake were conducted, analyzed, and compared with mathematical models. Author (USGRDR)

N69-22908*# National Aeronautics And Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIRECT MEASUREMENTS OF THE SIZE AND AMPLITUDE OR IRREGULARITIES IN THE TOPSIDE IONOSPHERE
P. L. Dyson Feb. 1969 43 p refs Submitted for publication
(NASA-TM-X-63512; X-621-69-57) Avail: CFSTI CSCL 04A

Data obtained form the Alouette 2 Langmuir probe experiment during a 3 month period have been examined for effects due to electron density irregularities (fine structure). Irregularities occur in patches hundreds of kilometers in horizontal extent, and individual irregularities have amplitudes between 5% and 70% and dimensions of less than 2 km along the satellite path. These irregularities appear more often at night than during the day and they occur in a region which is centered on the auroral oval and extends to both higher and lower latitudes. Comparison of the probe data with Alouette 2 ionograms obtained simultaneously shows that spread F occurred at the height of the satellite whenever fine structure was observed. However, particularly at mid latitudes, spread F often occurs at the satellite even when the probe does not detect irregularities. When spread F occurs, but probe does not observe fine structure, the irregularities are less than 5% in amplitude. Several irregularity production mechanisms which could account for the results are discussed. Author

N69-22913# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF THE REVERSE-COMBINATION DETECTING METHOD TO SUPPRESS MULTIPLE REFLECTED WAVES
Pi-Chien Ts'Ai and T'ing-Chang Wang Aug. 1968 30 p refs Transl. into ENGLISH from Ti Ch'iu Wu Li Hsueh Pao (China), v. 14, no. 4, 1965 p 227–241
(AD-681614; FTD-HT-23-39-68) Avail: CFSTI CSCL 8/11

When interfaces producing multiply reflected waves are nearly horizontal and those in the deep section are comparatively inclined, it is possible to suppress high-apparent-velocity multiply reflected waves and to distinguish low-apparent-velocity waves reflected from the deep section through a reverse combination of detectors. In this article, directivity and phase characteristics of reverse combination are discussed, with emphasis placed on study of conditions for spherical reflected waves and on description of the peculiarities of operating methods. From analyses of practical results, it is made clear that the reverse-combination detecting method is an effective method of suppressing multiply reflected waves. Author (TAB)

N69-22916# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
MATHEMATICAL MODEL STUDY OF THE PROPAGATION OF TIDES IN THE SAINT LAWRENCE RIVER AND ESTUARY
J. W. Kamphuis Aug. 1968 71 p refs
(NRC-10541) Avail: CFSTI

A mathematical study of the tidal motion in the St. Lawrence River and Estuary is presented. Three different types of finite difference models are discussed in detail, one explicit scheme and two implicit schemes. The differential equations are derived and methods of schematization are discussed. Subsequently, for each of the models the finite difference equations, the methods of solution, stability, convergence, and final results are given and the models are compared as to their relative advantages and usefulness. Author

N69-22954# Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.
VARIATIONS IN ISOTOPIC ABUNDANCES OF STRONTIUM, CALCIUM, AND ARGON AND RELATED TOPICS Annual Progress Report, 1968
1 Dec. 1968 159 p refs
(Contract AT(30-1)-1381)
(MIT-1381-16; APR-16) Avail: CFSTI

The results of radiometric age data on two-thirds of the continental area of the earth are presented, and the significance of these data to the continental drift theory examined. The Rb and Sr isotopic compositions of Canadian gangue minerals and syenitic rocks were analyzed. The $^{86}Sr/^{87}Sr$ ratios of chemocktite and granitic rocks from the Adirondacks, Ontario, Uganda, Tanzania, and India were determined. The results of age estimations and isotopic analyses of rocks, mainly gneisses, from Columbia, British Honduras, Gabon, Liberia, Venezuela, and Sierra Leone, and of Canadian Huronian sediments, Connecticut pegmatite, and Massachusetts rhyolites are given. Reprints of papers on K, Rb, and Sr distribution on the earth, the Continental Drift Theory, and the age of Canadian and South American rocks, as well as abstracts of papers presented at the Geological Society of America meetings of 1967 and 1968, are included. Author (NSA)

N69-23001# Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
AN ANALYSIS OF EVAPORATION OF LAKE HEFNER, 1965–1966, BASED ON THE WATER BUDGET, ENERGY BUDGET, AND EVAPORATION TANKS
James Butler Allen (Ph.D. Thesis) Jul. 1968 208 p refs
(Contract DI-14-06-D-5629)
(PB-180339) Avail: CFSTI CSCL 13B

A large scale investigation of evaporation was carried out at Lake Hefner, Oklahoma, during the spring, summer, and fall of 1965 and 1966. The lake evaporation was measured using (1) a water budget method of proven accuracy, and (2) an energy budget method. The most important objective of this study was to investigate the relationship between lake evaporation and evaporation from large sunken tanks and a pond. A prediction equation was developed using evaportation rates and water surface temperatures of the lake and 15-foot tank, plus the 2-meter air temperature and relative humidity. USGRDR

N69-23146# Joint Publications Research Service, Washington, D. C.
UNDERWATER EXPLOITATION OF MINERAL RESOURCES

V. N. Kostin et al 24 Mar. 1969 10 p refs Transl. into ENGLISH from Gorn. Zh. (Moscow), Feb. 1969 p 25–28
(JPRS-47700) Avail: CFSTI

World-wide experiences in underwater exploitation of mineral resources are reviewed, and the Soviet Union's experimental-industrial work is discussed. This experimental exploitation was for ilmenite–rutile–zirconium in the Baltic Sea. The mining and separating procedures and equipment are described. It is felt that the research indicates a national economic significance in underwater prospecting. N.E.N.

N69-23202# Joint Publications Research Service, Washington, D. C.
RADIOMETER MEASUREMENTS OF WATER SURFACE TEMPERATURE
N. P. Smirnova et al 21 Mar. 1969 20 p refs Transl. into ENGLISH from Vestn. Leningrad. Univ. (Leningrad), v. 1, no. 6, 1968 p 108–120
(JPRS-47698) Avail: CFSTI

In connection with the need for more exact methods of measuring water surface temperature, including the thin layer underlying the surface, and to establish the existence of the layer of negative gradients, a simple contactless method was developed which may be implemented by various types of radiometers. This approach is based on the fact that high accuracy in obtaining water surface temperature is theoretically possible only by determining the flux magnitude of the characteristic thermal surface radiation. Existing conventional methods are reviewed, and a description of the radiometer measurements is given which confirm the presence of a negative gradient in the upper layer of water (20 to 30 μk). A.C.R.

N69-23207# Stanford Research Inst., Menlo Park, Calif.
THE COUNTING OF LIGHTNING FLASHES Special Technical Report Number 49
Edward T. Pierce Jun. 1968 97 p refs
(Contract DA-36-039-AMC-00040(E); ARPA Order 371)
(AD-682023) Avail: CFSTI CSCL 4/1

The principles involved in using lightning-flash counters are first discussed, with especial reference to the ERA and CCIR types of counter. The concept of an effective range is introduced, and it is shown how the value obtained for the effective range is influence by counter sensitivity and by the amplitude distribution of the lightning-generated signals at the thunderstorm source. The results obtained at two sites in Thailand with ERA and CCIR counters are presented, analyzed, and compared with data for Singapore. It is established that during months of high thunderstorm incidence the lightning-flash density is proportional to the square of the well-known thunderstorm-day parameter; for low-activity months, the proportionality is direct. The transition between the two laws occurs when the number of thunderstorm days per month, T sub m, is about three. Over most of Thailand T sub m always exceeds three except during the months of December through February. Seasonal and diurnal variational patterns in lightning incidence are derived. Monthly changes are related, as indicated above, to the T sub m statistic. As regards diurnal variation, from March to June thunderstorms tend to break out in the local afternoon; later in the year the peak activity moves to the early evening and night hours. Author (TAB)

N69-23210# Ocean Science and Engineering, Inc., Riviera Beach, Fla.
LONG PERIOD WAVE GAUGE DEVELOPMENT. PHASE 5: PRESSURE SENSOR SURVEY, COMPUTER ANALYSIS, SENSOR SUSPENSION SHIP MOTION STUDY. PHASE 6: SENSOR SYSTEM FABRICATION. PHASE 7: CONDUCTING TETHER FABRICATION, EARLY WARNING SYSTEM FABRICATION, MOORING RETRIEVAL WINCH FABRICATION Final Report
12 Jun. 1968 67 p refs
(Contract AT(26-1)-280)
(PB-180832; NVO-280-4, C-261) Avail: CFSTI CSCL 8/3

The report covers the following: Phase V, perform an analog study of a deeper suspended sensor system using existing computer models. Phase VI, expedite the procurement of three sensors to meet Commission specifications. Phase VII, provide the Commission with all hardware necessary to complete the Early Warning System. Author (USGRDR)

N69-23217# Environmental Science Services Administration, Washington, D. C.
MAN'S GEOPHYSICAL ENVIRONMENT: ITS STUDY FROM SPACE
John D. Bossler et al Mar. 1968 146 p refs
Avail: SOD $2.00

A review of present and future space vehicles available to scientific users shows a wide range of payload capabilities from small special purpose satellites to large manned or unmanned observatories. For the Saturn class vehicles, and using modified Apollo hardware, experimental payloads of the order of 10,000 lbs, 1 to 5 kilowatt power and several hundred cubic feet volume may become available for both low and earth synchronous orbits. In addition to mission importance the following selection criteria were considered: technical feasibility and hardware availability, possible multipurpose utilization of instrumentation and data superiority over conventional methods, and several other considerations. Author

N69-23244# TRW Systems, Redondo Beach, Calif. Ocean Systems Dept.
SIGNIFICANCE OF REMOTE OBSERVABLES TO FISHERIES
R. H. Douglas and S. Gorenbein 15 Jan. 1968 47 p refs
(TRW-99900-6595-R000) Avail: Issuing Activity

The feasibility of using aircraft and spacecraft equipped with remote sensing equipment in observation of oceanic phenomena to aid fishery resource exploitation is discussed, and the progress of remote sensing technology for use in this area is reported. An affirmative conclusion was reached on the application of such methods, based on the following procedures: (1) identification of the oceanic characteristics and processes of primary interest and significance to fishery scientists and fishermen; and (2) assessment of the correlation between observables available through existing sensor technology and these characteristics and processes. It is emphasized that the study is indicative, not definitive, of the feasibility of this method, since no demonstration program to gather data has been conducted, and it is recommended that such a program be implemented in the near future. A.C.R.

N69-23303# Lockheed Missiles and Space Co., Palo Alto, Calif.
APROPOS THE PAPER BY V. I. KRASOVSKII "ON INFRARED RADIATION OF THE UPPER ATMOSPHERE"
M. N. Markov et al [1969] 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 157–159
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A restatement of a previously published article, in response to refutation of the findings, is presented. The effects contributed by the aurora borealis, resonance absorption, atmospheric composition, and hydrostatics to the radiation in the atmosphere are discussed. It is concluded that the only explanation of the IR fluxes is due to solar radiation. N.E.N.

N69-23304# Directorate of Scientific Information Services, Ottawa (Ontario).
ON THE EQUATIONS OF THE INERTIA-GRAVITY FIELD

L. D. Raigorodski Jan. 1969 3 p refs Transl. into ENGLISH from Izv. Vysshikh. Uchebn. Zavedenii, Fiz. (Tomsk), v. 6, 1968 p 96–97
(PRB-T-512-R) Avail: CFSTI

The application of Maxwell-type equations in gravity theory without giving up the hypothesis of geodesics is discussed. Mathematical models are used to solve equations of motion in the gravity field to prove that there exists an inertia-gravity field, describable by equations of Maxwell type, in which the motion of free particles is in agreement with deodesics. B.G.D.

N69-23318*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ATLAS OF TIROS 7 MONTHLY MAPS OF EMITTED RADIATION IN THE 8/12 MICRON ATMOSPHERIC WINDOW OVER THE INDIAN OCEAN AREA
Earl R. Kreins and Lewis J. Allison Washington Apr. 1969 28 p refs
(NASA-TN-D-5101) Avail: CFSTI CSCL 04B

The Tiros 7 meteorological satellite contained a five channel medium resolution scanning radiometer. One of the channels responded to emitted radiation in the 8- to 12-micron portion of the electromagnetic spectrum, where gaseous absorption in the atmosphere is minimal and, therefore, the radiation detected at the satellite originates mainly from the earth's surface and/or clouds. Data from this channel have been compiled and mapped in a series of one 12-day mean map (June 1963) and 18 monthly mean maps (July 1963 through December 1964) of equivalent blackbody temperatures. The maps cover the area enclosed by 45 degrees north latidue, 50 degrees south latitude, 20 degrees east longitude, and 155 degrees east longitude. These satellite observations were originally analyzed in support of the International Indian Ocean Expedition. They are presented in a separate, compact form for users who are interested primarily in the radiation data and in details concerning the processing, display, analysis, and interpretation of these data. Author

N69-23330*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
OGO-3 OBSERVATIONS OF ELF NOISE IN THE MAGNETOSPHERE: PART 1: SPATIAL EXTENT AND FREQUENCY OF OCCURRENCE
Christopher T. Russell, Robert E. Holzer, and Edward J. Smith (JPL) [1968] 60 p refs Prepared in cooperation with JPL
(Contract NAS7-100)
(NASA-CR-98702) Avail: CFSTI CSCL 08N

The magnetic noise in the magnetosphere in the frequency range from 10 to 800 was measured by the spectrum analyzers of the search coil magnetometer on OGO-3. A statistical study is presented of the spatial extent and frequency of occurrence of noise at the higher end of this passband and the frequencies at which noise above the detector thresholds is most common within the magnetosphere. The local time and magnetic latitude distribution of two classes of signals were investigated. Author

N69-23334# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE MOUNTAINS OF THE CENTRAL PART OF QUEEN MAUD LAND Results of Researches in the International Geophysical Year
V. I. Bardin 1968 128 p refs Transl. into ENGLISH of the book "Gory Tsentral'noi Chasti Zemli Korolevy Mod. Rezul'taty Issledovanii po Programme Mezhdunarodnogo Geofizicheskogo Goda" Moscow, Izd. Nauka, Glaciol. Sect. 9 of IGY Mezhdunarodnogo Geofizicheskogo Goda" Moscow, Izd. Nauka, 1968 Published for USF *its* Glaciol. Sect. 9 of IGY Program No. 15
(TT-68-50314) Copyright. Avail: CFSTI

A regional geographical description is presented providing the principal data of surface and visual air investigations in the mountains of Queen Maud Land. Glaciogeomorphological descriptions of individual mountain regions are given, along with photographs, and opinions are offered concerning future geographical explorations. The principal features of the present-day physiographic landscape, its formation, and its development are discussed. Results of laboratory processing of specimens collected in Antarctica are examined, providing information on chemical weathering processes, chemical compositions of water and snow, and vegetation. The study is based on data collected during geologic-geographic explorations carried out by the fifth and sixth Soviet Antarctic expeditions during 1960 and 1961. P.A.B.

N69-23335# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JET STREAMS IN THE ATMOSPHERIC BOUNDARY LAYER
P. A. Vorontsov 13 Aug. 1968 28 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 205, 1967 p 77–92
(AD-681619; FTD-MT-24-229-68) Avail: CFSTI CSCL 4/1

Consideration is given to cases with sharp intensifications of wind velocity in the boundary layer, sometimes exceeding the speed of geostrophic wind, and certain considerations about the physics of the process are given. Author (TAB)

N69-23343# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON INFRARED RADIATION OF THE UPPER ATMOSPHERE
V. I. Krasovskii [1968] 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 943–946
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The minimum and maximum energy emissions in the upper atmosphere are analyzed based on a review of existing theories and observations at various altitudes. It is emphasized that the most abundant components of the upper atmosphere, O, N_2, O_2 and N do not radiate in the domain of several microns, and that only vibrationally excited diatomic molecules consisting of different atoms, such as nitric oxide (NO) can cause the emission. However, if such components are contained in this region, they are present in insignificant amounts. Various aspects of this assumption are discussed in relation to infrared emission, taking into account solar electromagnetic radiation and the thickness of the emitting layer. It is concluded that more detailed and reliable information is necessary on this subject, particularly when secondary artificial processes, such as the effects of supersonic vehicle launching into the atmosphere, are considered. A.C.R.

N69-23349# Israel Program for Scientific Translations, Ltd., Jerusalem.
RECENT SEDIMENTATION IN THE BERING SEA
A. P. Lisitsyn 1969 622 p refs Transl. into ENGLISH of the book "Protsessy Sovremennogo Osadkoobrazovaniya v Beringovom More" Moscow, Izd. Nauka, 1966 Published for NSF
(TT-68-50315) Copyright. Avail: CFSTI

Sedimentation in the recent Bering basin was investigated in an attempt to solve several problems in the theory of sedimentation. An assessment is made of the physiographic features of the Bering Sea and its sedimentary influx, and of sedimentation conditions in the Sea. Also examined are the quantitative distribution of sedimentary material (suspension) and its qualitative composition, the types of bottom sediments and their mechanical compositions, and the mineralogy and petrography of bottom sediments. Regularities governing distribution of major chemical components in sediments and their genesis are delineated. It was concluded that, despite the high complexity of the interaction of the different factors and their large number, it is possible to establish

the major factors which determine the specific characteristics of Bering Sea sediments and their similarities and dissimilarities with respect to sediments in other water bodies. M.G.J.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-22059 Wisconsin Univ., Madison.
VIBRATION RESPONSE OF A RATE GYRO MOUNTED ON AN ELASTIC PLATE
Enrique Jaime Chicurel (Ph.D. Thesis) 1968 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-9068

A mathematical model is developed for the vibrational response of a single axis rate gyro mounted on a simply supported elastic plate. The plate supports are subjected to general angular vibrations thus inducing vibrations in the rate gyro. The dynamic response of the system is simulated on a digital computer with numerical results presented for several configurations. In particular, the effects of plate thickness, density, imposed frequency and gyro height above plate were studied. It is shown that the average output response of the gyro is not significantly affected by the elastic support for the range of parameters studied. Dissert. Abstr.

N69-22065 Stanford Univ., Calif.
A REAL-TIME DIGITAL SPECTRUM ANALYZER
Robert Burns McCullough (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-11321

The possibilities of doing spectral analysis digitally in real time is examined. A new real-time algorithm is developed which is well suited to both hardware implementation and real-time operation. Features of this new algorithm are: continuous processing rather than batch processing; total storage requirements of only $(3/2)n-2$ samples in shift registers; inexpensive shift registers may be used since only the inputs and outputs are looked at; operating speed is well above that of other existing algorithms; output is suitable for direct digital-to-analog conversion and oscilloscope display; and sequencing circuitry is minimized since all timing can be derived from a single m-bit binary counter for 2^m samples. Convenient closed-form analytic expressions for the passband characteristics of various digital transform techniques are derived, and used to examine and compare the effectiveness of various passband shaping techniques both in the time domain and in the frequency domain. Modifications are made to the real-time algorithm to permit passband shaping. The design for a complete digital spectrum analyzer is developed. Dissert. Abstr.

N69-22200# Idaho Nuclear Corp., Idaho Falls.
QUALITY CONTROL PROGRAM FOR COUNTING INSTRUMENTS AND TECHNIQUES USED IN THE RADIO AND SPECIAL ANALYSIS LABORATORY Quarterly Report, 1 Jan.–31 Mar. 1968
J. W. Brothers, A. C. Hill, C. M. Wilcox, and J. G. Scott Nov. 1968 55 p refs
(Contract AT(10-1)-1230)
(IN-1255) Avail: CFSTI

Sources of Pu-239 and UX_2 were counted respectively with the gross-alpha and beta counters. Single nuclides including Cs-137 and I-131 were analyzed using the NaI(Tl) detection system. A mixed source of I-131, Tel-132, Te-129, Cs-137, and Ru-103 was analyzed using the SHIFTY III computer program for calculation of the NaI(Tl) spectral data. A mixed source of Ce-Pr-144, Ru-106, Cs-137, and Zr-Nb-95 was analyzed by gamma nullification of NaI(Tl) spectral data using a ND-180, 512-channel analyzer. Author (NSA)

N69-22204# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Soil Mechanics.
A TERRAIN EVALUATION SYSTEM FOR ENGINEERING
K. Grant 3 Apr. 1968 28 p refs
(PB-180800; TP-2) Avail: CFSTI CSCL 13B

The principles and concepts evolved for a scheme of terrain classification are discussed in detail in this paper. A scheme operating at four levels of generalization, known as province, terrain pattern, terrain unit, and terrain component, is suggested. The terrain covered by each level of generalization is defined and a numerical system of labelling for each level of generalization is proposed and explained. The methodology of operating the suggested terrain classification system is discussed and the role of aerial photographs is examined. The classification is based first on aerial photograph interpretation, but the classification so obtained is not regarded as valid until it has been checked in the field. The implementation of the terrain classification scheme and its engineering interpretation are considered. Author (USGRDR)

N69-22250# University Corp. for Atmospheric Research, Boulder, Colo.
DIFFERENTIAL THERMISTOR ANEMOMETER
Julian M. Pike [1968] 5 p
(Contract NSF C460)
(PB-180871) Avail: CFSTI CSCL 04B

Transducers measuring wind by means of the cooling effect of the airstream are most useful at relatively low velocities. The extension of usefulness to higher velocities may be made by reducing the velocity of flow through the transducer to a small value proportional to the external velocity. This principle is used in the differential thermistor anemometer. Author (USGRDR)

N69-22285# HAND Corp., Santa Monica, Calif.
PSEUDOCOLOR AS A MEANS OF IMAGE ENHANCEMENT
Joseph J. Sheppard, Jr., Roy H. Stratton, and Carl Gazley, Jr. Jan. 1969 34 p refs Presented at the ann. meeting of the Am. Acad. of Optometry, Beverly Hills, 7–10 Dec. 1968
(AD-681492; P-3988) Avail: CFSTI CSCL 14/5

For human observers the number of distinguishably different colors is much larger than the number of distinguishable different shades of gray. Therefore, if the scale of grays in a complex black-and-white image, such as an X-ray, is transformed into some suitable scale of colors, perception of the details in that image will be greatly enhanced. In one versatile but expensive method of producing such pseudocolor images, the black-and-white image is photoelectrically scanned and a computer is used to produce three pseudocolor separation positives (or negatives) directly on 35-mm film. A simpler and inexpensive method has been developed which uses purely photographic procedures. Examples of results with this procedure applied to chromosome photomicrographs, X-ray films, and pathological specimens are presented. Author (TAB)

N69-22264# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERIAL CAMERA AFA-TES-7 AND ITS TESTS

V. B. Ilin and V. D. Derviz Jul. 1968 17 p refs Transl. into ENGLISH from TR. TSENTR. Nauchn. Issled Inst. Geodezii, Aeros Yemki i Kartografii (Moscow), no. 165, 1966 p. 94-101
(AD-681644; FTD-MT-24-231-68) Avail: CFSTI CSCL 14/5

The AFA-TES-7 camera described has a focal length of 70 mm and produces a photo of 180 x 180 mm. The article discusses an objective with frame and equalizing glass; ZBS-M speed shutter; quality of aerial film equalization; control panel; thermal insulation of the camera; sensitometric wedge; resolving power, light distribution, and dispersion; and automatic exposure and describes tests of each. Author (TAB)

N69-22267# Arctic Inst. of North America, Washington, D. C.
SYMPOSIUM ON REMOTE SENSING IN THE POLAR REGIONS
1968 70 p Symp. held at Easton, Md., 6-8 Mar. 1968
(AD-682240) CSCL 14/2

The Arctic Institute of North America long has been interested in encouraging full and specific attention to applications of remote sensing to polar-research problems. The major purpose of the symposium was to acquaint scientists and technicians concerned with remote sensing with some of the special problems of the polar areas and, in turn, to acquaint polar scientists with the potential of the use of remote sensing. The Symposium therefore was designed to foster an exchange of ideas between the users and potential users of remote sensing, and instrumentation and interpretation specialists. Author (TAB)

N69-22297# Sandia Corp., Livermore, Calif.
TERRABALLISTIC PROJECTILES SIMPLIFY REMOTE PRELIMINARY INVESTIGATIONS
Robert L. McNeill (Woodward-Clyde-Sherard and Associates, Oakland, Calif.), and B. Edward Margason (Woodward-Clyde-Sherard and Associates, Oakland, Calif.) [1968] 29 p refs Supported by AEC Prepared in cooperation with Woodward-Clyde-Sherard and Associates, Oakland, Calif.)
(SC-CR-68-3735; PB-180859) Avail: CFSTI CSCL 08G

A subsurface-sensing device which can be used for preliminary investigations of remote and inaccessible areas has been under development. The technique involves dropping or otherwise propelling a projectile which penetrates the ground. The projectile, which is ballistic throughout its trajectory in the ground, contains instruments to measure the forces felt during penetration, and telementry equipment to transmit the instrument signals to a ground or airborne receiver. Study of these signals yields approximate subsurface data. Well over 700 full-scale field tests have been conducted. All of the tests were carried out in natural soil and rock materials. (USGRDR)

N69-22306# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
A SPHERICAL INTERFEROMETER WITH WHITE LIGHT COMPENSATION
R. R. Baldwin 24 Dec. 1968 23 p refs
(Contract W-7405-eng-26)
(Y-1658) Avail: CFSTI

A modified form of a white-light compensated Twyman-Green interferometer has been recently developed which can determine both the size and sphericity of concave spherical surfaces. The interferometer has an included field of view in excess of 110° and will accommodate any specularly reflective concave spherical surface two inches or less in radius. Expected accuracy of the interferometer is ±5 microinches for both size and sphericity, and repeatability should approach ± microinch. Author (NSA)

N69-22315# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.
DEVELOPMENT OF THERMOCOUPLE-TYPE TOTAL TEMPERATURE PROBES IN THE HYPERSONIC FLOW REGIME, SEPTEMBER 1965-MARCH 1968
P. J. Bontrager Jan. 1969 73 p refs
(Contract F40600-69-C-0001)
(AD-681489; AEDC-TR-69-25) Avail: CFSTI CSCL 14/2

An experimental study to develop the criterion necessary to construct a miniature shielded thermocouple total temperature probe suitable for application in the hypersonic flow regime. Particular emphasis was given to the effect that internal velocity and thermocouple junction location relative to the shield entrance had on temperature measurements. An error analysis resulting from heat transfer phenomenon was made. The measured total temperature-to-tunnel stilling chamber temperature ratio was correlated in terms of the entrance flow length-to-probe length ratio. Over the range of parameters investigated both the optimum length-to-diameter and the optimum entrance-to-vent area ratios were found to be two. The entrance flow length-to-probe length ratios effectively correlated the data from probes of a given internal diameter. Author (TAB)

N69-22321*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COLOR ENHANCEMENT OF NIMBUS HIGH RESOLUTION INFRARED RADIOMETER DATA
Earl R. Kreins and Lewis J. Allison Mar. 1969 28 p refs
(NASA-TM-X-63503; X-622-69-86) Avail: CFSTI CSCL 20F

Two examples of Nimbus High Resolution Infrared Radiometer (HRIR) data processed by a color display enhancement system demonstrate possible meteorological, oceanographic, and geomorphological applications of this technique for geophysical research. A commonly used means of displaying radiation temperatures mapped by the HRIR has been a black and white photofacsimile film strip. However, the human eye can distinguish many more colors than shades of gray, and this characteristic permits an analyst to evaluate quantitatively radiation values mapped in color more readily than in black and white. Author

N69-22326# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF GYROSCOPIC DEVICES, VOLUME 1, PART 1
S. S. Rivkin Dec. 1968 268 p refs Transl. into ENGLISH from Teoriya Giroskopicheskikh Ustroistv (Leningrad), Ch 1/4, 1962
(AD-682103; FTD-HT-23-38-68-Vol-1-Pt-1) Avail: CFSTI CSCL 17/7

The fundamentals of the applied theory of gyroscopes and gyroscopic devices (GD) based on the use of an astatic gyroscope with three degrees of freedom without correction and with a pendulum correction system. The methods used in applied gyroscopy and methods of automatic control theory are also used to determine the errors of the GD. Author

N69-22406# Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.
A LOW LEVEL ENVIRONMENTAL RADIATION MONITOR WITH HIGH SENSITIVITY, STABILITY, AND DYNAMIC RANGE
Thomas E. Cassada Oct. 1968 9 p refs Presented at the 15th Nucl. Sci. Symp., Montreal
(CONF-681017-14) Avail: CFSTI

An environmental radiation monitor is described which records gamma radiation levels with a logarithmic response over a dynamic

range of four decades (0.01 mR/hr to 100 mR/hr achievable without range switching). Constant temperature accuracy is greater than ±10% of indicated reading throughout 3.5 decades of the four decade range. A high degree of temperature stability is achieved (error due to temperature change is less than ±20% of reading over an ambient temperature range of −10°C to +55°C). Solid state electronic circuitry is utilized exclusively for increased reliability and long term stability. (Author) NSA

N69-22412# Wilcox Electric Co., Inc., Kansas City, Mo.
A STUDY OF TWO FREQUENCY CAPTURE EFFECTS ON ILS RECEIVERS Final Report
Charles Manney Mar. 1969 105 p refs
(Contract FA-66-WA-1556)
(SRDS-RD-69-12) Avail: Issuing Activity

The specific objective was the combined theoretical and experimental study of the response of navigational receivers in two-frequency instrument landing systems. The purpose was to obtain factual understanding of reported malfunctions that could not be pinpointed at the time: whether caused by basic defects in the space modulation produced by the two-frequency ILS ground station, incompatibility between ground and airborne equipment, or malfunction concentrated in the receiving equipment. A secondary objective was to obtain greater understanding of capture effect as it applies to ILS and to produce exact, analytical procedures for conducting the investigation, rather than build from the many approximations developed from preceding studies. Author

N69-22440# Deutsche Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Institut fuer Steuer- und Regeltechnik.
A SURVEY OF LITERATURE CONCERNING SELF-NOISE REDUCTION IN ACOUSTICAL TRANSDUCERS USED FOR MEASUREMENTS IN FLOWING AIR [ZUR VERMINDERUNG DES EIGENGERAEUSCHES AN SCHALLEMPFAENGERN IN STROEMENDER LUFT (LITERATURZUSAMMENFASSUND)]
S. Waldschuetz Dec. 1968 73 p refs In GERMAN; ENGLISH summary
(DVL-775; DLR-Mitt-68-31) Avail: CFSTI

The signals of an acoustical transducer used for measurements in flowing air contain noise components which are frequently called self noise. This self noise is caused by flow instabilities and by vortices and boundary pressure fluctuations resulting from placing the acoustical transducer or mounting fixture into the air flow. This report surveys available literature describing methods of reducing this self noise. The referenced literature pertains mostly to acoustical pressure transducers used in air flows with velocities lower than that of sound and is very general with few quantitative details. Author

N69-22463# British Steel Corp., London (England). Plant Engineering and Energy Div.
HIGH TEMPERATURE TELEMETRY EQUIPMENT FOR REHEATING FURNACE STUDIES
D. J. Standley, J. Moran, W. T. Kodz, and K. P. Ide 1968 29 p refs
(PB-180444; PE/A/45/67) Avail: CFSTI CSCL 1/F

Telemetry equipment to measure slab temperatures in reheating furnace trials is described and the factors influencing accuracy in the furnace environment are analysed. The results show that the design problems encountered in operating this equipment at elevated temperatures have been solved. Special care is needed in connecting thermocouples to the equipment and in converting the received information into a suitable indication of slab temperature. Author (USGRDR)

N69-22471# California Univ., Berkeley. Hydraulic Engineering Lab.
HISTORY OF SHORE GROWTH FROM ANALYSIS OF AERIAL PHOTOGRAPHS
Francis H. Moffitt Dec. 1968 14 p refs
(Contract DACW72-67-C-0015)
(AD-681924; HEL-2-21) Avail: CFSTI CSCL 08/3

An analysis was made of a heterogeneous mixture of dated aerial photographs of various scales, taken from different flying heights, and with aerial cameras of different focal lengths. The general area of the shore to be documented was defined on each photograph of the collection. Two systems of correlation were employed to fix the position of a shore line with respect to cultural features. The most direct system is that which relates the shore line directly to some horizontal datum such as a state plane coordinate system. If the absolute position of the shore line is not required, a system of direct scaling from correlated features to the shore line can be used. B.P.

N69-22472# Institut für Angewandte Geodaesie, Frankfurt am Main (West Germany).
ON ASTROMETRIC EVALUATION OF PHOTOGRAPHIC SATELLITE OBSERVATIONS [ZUR ASTROMETRISCHEN AUSWERTUNG PHOTOGRAPHISCHER SATELLITENAUFNAHMEN]
G. Zimmermann Oct. 1968 32 p refs In GERMAN; ENGLISH summary Sponsored by BMwF
(BMwF-FBW-68-67) Avail: CFSTI

In this report the author describes the working methods of evaluating satellite photographs by the astrometric procedure. Two details, viz. the automatical identification of stars and the approximation of ideal image coordinates are illustrated by means of arithmetical examples. Author (ESRO)

N69-22477# Centre National de la Recherche Scientifique, Verrières-le-Buisson (France). Service d'Aéronomie.
LYMAN-ALPHA CALIBRATION SOURCES [SOURCES DE CALIBRATION LYMAN-ALPHA]
P. Balaskovic *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 9–29 refs In FRENCH
(See N69-22476 11-03)
Avail: CFSTI

Different types of Lyman-alpha sources developed by the Service d'Aéronomie (CNRS, France) are described. The physical parameters which attract line profiles are reviewed and the optimum characteristics of sources for exciting the optical resonance of hydrogen atoms are deduced. The performance of discharge sources and electron excitation sources are compared. The technical problems of calibrating onboard sources, and their solution, are discussed and the aging and stability of sources are also considered. Author (ESRO)

N69-22478# Centre National de la Recherche Scientifique, Verrières-le-Buisson (France). Service d'Aéronomie.
UTILIZATION OF A HYDROGEN CELL FOR ABSOLUTE CALIBRATION AT 1216 Å [UTILISATION D'UNE CELLULE A HYDROGENE POUR UNE CALIBRATION ABSOLUE A 1216 Å]
S. Cazes and J. Huriet *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 31–44 In FRENCH (See N69-22476 11-03)
Avail: CFSTI

An absolute calibration method for Lyman-alpha sources based on the resonance of hydrogen atoms is presented. The resonance cell and its calibration are also described in detail. The output is measured with the aid of a resonance line obtained from a Lyman-alpha source and an identical cell. The response of the cell, obtained by varying the optical thickness, is directly linked to the profile of the incident line and is calibrated by comparison with lines of known geometric form. A computer program has been set up to produce the profile of Lyman-alpha emission lines.
Author (ESRO)

N69-22479# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany). Extraterrestriche Physik Inst.

THERMAL PLASMA AS A RADIATION STANDARD FOR WAVELENGTHS $\lambda > 1000$ Å

G. Boldt *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 45–51 (See N69-22476 11-03)
Avail: CFSTI

The light source for producing normal intensities is a wall-stabilised cascade arc. The arc channel having a diameter of 6 mm is formed by a set of perforated copper discs. The plasma of the arc is a thermal argon plasma having a temperature of about 14,000°K in its axis and a pressure of 1 atm. A small amount of another gas – hydrogen, nitrogen, carbon dioxide or krypton – is added to the argon plasma in such a way that only part of the arc column is seeded continuum. Most of these UV-lines are resonance lines or lines combining with a lower level near to the ground level and are therefore optically thick, which means that the intensity in the centre of these UV-lines is given by the Kirchhoff-Planck function. Since the plasma temperature is known with an accuracy of 2 per cent, the intensities in the centre of the optically thick U-lines are defined with an accuracy of 20 per cent or better, and can be used as normal intensities. The connection of the light source to the vacuum system is effected by means of a differential pumping system.
Author (ESRO)

N69-22480# Kernforschungsanlage, Julich (West Germany). Inst. für Plasmaphysik.

USE OF A THETA-PINCH FOR CALIBRATION IN THE ULTRAVIOLET AND SOFT X-RAY REGIONS

P. Bogen, D. Rusbüldt, and J. Schluter *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 refs p 53–56 (See N69-22476 11-30)
Avail: CFSTI

Theta-pinches in hydrogen or helium emit easily reproducible continuum radiation over a wide spectral range ($\lambda > 3$ Å), and are therefore useful as radiation standards. The emitted continuum is mainly bremsstrahlung, and its intensity per frequency unit I_ν can be calculated when the electron and ion densities N_e and N_i and the electron temperature T are known. The equation $I_\nu = \text{const. } N_i N_e (kT)^{-1/2} g(\nu,T) \exp(-h\nu/kT)$ ($g(\nu,T)$ = Gaunt factor for free-free radiation) has been checked in the domain 0.26-25 μ. In the case where $h\nu << kT$, I_ν is nearly independent of ν. We have used a theta-pinch plasma with $T \approx 10^6$ °K for the intensity calibration of a spectrometer between 1100 Å and 3500 Å has been used. In the soft X-ray domain, where $h\nu > kT$, the strong dependence on T and the contributions of the free-bound continua of impurity ions make the accurate prediction of the intensity difficult. This intensity has been deduced from separate measurements of the transmission of the wavelength selector (spectrometer or filter) and of the sensitivity of the detector (plastic scintillator or Si-diode). For rather clean hydrogen plasmas, rough agreement between calculated and measured intensities has been found.
Author (ESRO)

N69-22481# United Kingdom Atomic Energy Authority, Culham (England). Astrophysics Research Unit.

THE BRANCHING RATIOS METHOD OF INTENSITY CALIBRATION IN THE VACUUM ULTRAVIOLET

B. C. Boland, T. J. L. Jones, and R. W. P. McWhirter *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 59–65 (See N69-22476 11-30)
Avail: CFSTI

Two spectral lines arising from the same upper level are observed. The intensity of one is measured and that of the other, chosen in the desired spectral region, is deduced. For the method to be reliable the source must be optically thin so that no re-absorption takes place within the source. This is achieved by varying the concentration of the generating element during the observation of the line ratios. The required value of this ratio is approached asymptotically as the concentration is diminished. In the laboratory this method has distinct merits in that the same plasma source used for spectral intensity measurements can also be used for the calibration of spectrometer and detector, by seeding with small amounts of the required line-producing ions. Results have been obtained from this method for intensity calibrations with hydrogen-like and lithium-like ions, in the spectral range 150 Å to 1640 Å. These results have been compared with the results of measurements using an X-ray tube and precision designed proportional counter from the carbon line at 40 Å to beryllium at 115 Å. Although the results do not overlap, nevertheless agreement between the two exists to within a margin of 50 per cent.
Author (ESRO)

N69-22482# Inst. for Atomic and Molecular Physics, Amsterdam (Netherlands).

ABSOLUTE CALIBRATION OF INTENSITY IN THE FAR ULTRAVIOLET BY MEANS OF ION OR ELECTRON IMPACT AND BY USING A MICROWAVE CAVITY AS A MONOCHROMATIC LIGHT SOURCE

F. W. Saris, B. F. J. Luyken, F. J. de Heer, and J. Aarts *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 67–74 refs (See N69-22476 11-30)
Avail: CFSTI

In the spectral region below about 1300 Å two fundamentally different methods for absolute light intensity calibration are used: a) In the branching ratio method two spectral lines are observed, one in the visible and one in the far ultraviolet which have the same upper level and which have known transition probabilities. By making use of certain ion-atom and electron-atom reactions, the problems of absorption of resonance radiation and fine structure in the spectral lines involved are avoided. If He^+ is fixed into Ne, one observes the radiation from the He($3\,^1P$) particles formed by electron capture. Firing electrons into aluminium and silicon vapour one can use spectral lines from excited Al III and Si IV levels. b) The microwave cavity can be used as an intensive light source of almost monochromatic radiation in the far ultraviolet. Use is made of the resonance radiation of different noble gases. The absolute intensity of this radiation is measured with a thermopile of known sensitivity.
Author (ESRO)

N69-22483# Landesstermwarte auf dem Koenigstuhl, Heidelberg (West Germany).

CALIBRATION OF Hg AND D_2 DISCHARGES IN THE SPECTRAL RANGE 1650 Å TO 2700 MEANS OF SYNCHROTRON RADIATION

E. Pitz *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 75–83 refs (See N69-22476 11-30)
Avail: CFSTI

By means of the synchrotron radiation (at DESY) light sources in the vacuum ultraviolet, such as the continuous spectra of Hg UV standards (1900 Å – 2500 Å) and of D_2-discharges (1650 Å – 2700 Å), have been calibrated for their intensity. The synchrotron radiation intensity is calibrated at a convenient visible wavelength with a tungsten ribbon lamp, which has already been

primarily calibrated with a black body. Thus – according to the Schwinger theory – the intensity of the synchrotron radiation is known for all other wavelengths and in the vacuum ultraviolet one can calibrate an unknown source. The wavelength-dependent part of the error is about 8 per cent. One can repeat the absolute calibration directly with the black body at about 2500 Å. This is necessary because the deuterium lamps change their intensity with time. Experiments with rare gas discharges (Xe, Kr, Ar) failed or gave unsatisfactory results. These lamps can be used for the calibration of photometers in the vacuum ultraviolet for extra-terrestrial experiments such as astronomical observations.
Author (ESRO)

N69-22489# United Kingdom Atomic Energy Authority, Culham (England). Astrophysics Research Unit.
VACUUM ULTRAVIOLET EFFICIENCY MEASUREMENTS OF MIRRORS, GRATINGS AND PHOTOGRAPHIC FILM
W. M. Burton, A. T. Hatter, and A. Ridgeley *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 145–158 refs (See N69-22476 11-30)
Avail: CFSTI

The ultraviolet emission spectrum of the sun has been studied by several groups in recent years. Instrumentation prepared at Culham has been used to obtain photographic spectra in the wavelength region below 3000 Å. To obtain data on solar emission line intensities from these spectra it is necessary to measure the efficiency of the instrumental system. The flight instrument uses a primary concave mirror to form an image of the sun at the slit of a normal incidence concave grating spectrograph. A strip of special UV sensitive photographic film is used to record the spectrum on the Rowland circle. To calibrate this system, separate measurements are made of mirror reflectivity, grating efficiency and photographic film sensitivity at various wavelengths between 700 Å and 3000 Å. The equipment designed for these measurements is described and some results are presented. Author (ESRO)

N69-22491# Liège Univ. (Belgium). Inst. d'Astrophysique.
CALIBRATION OF ASTRONOMICAL SATELLITES FOR FAR ULTRAVIOLET RADIATION MEASUREMENTS [ETALONNAGE DES SATELLITES ASTRONOMIQUES DANS L'U.V. LOINTAIN]
D. Malaise *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 169–172 In FRENCH (See N69-22476 11-30)
Avail: CFSTI

A description is given of the equipment used at Cointe-Sclessin (Belgium) for the calibration of satellite-borne far ultraviolet radiation instruments. It consists of a stainless steel container, a Cassegrain telescope and a calibrated radiation source and will become operational during 1969. ESRO

N69-22492# Centre National d'Etudes Spatiales, Brétigny-sur-Orge (France).
ABSOLUTE CALIBRATION OF DETECTORS AT λ = 1216Å [CALIBRATION ABSOLUE DES DETECTEURS A λ = 1216Å]
C. L. Guillard *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 173–182 refs In FRENCH (See N69-22476 11-30)
Avail: CFSTI

The different published methods for calibrating detectors which are sensitive to far ultraviolet radiation are reviewed. The method adopted by the CNES (France) is described and an account is given of its use in calibrating the photomultipliers and ionization chambers to be used in the French D2 satellite. ESRO

N69-22514# Los Alamos Scientific Lab., N. Mex.
CHARACTERISTICS OF MINIATURE AND TEFLON LiF THERMOLUMINESCENT DOSIMETERS
Allen M. Valentine Nov. 1968 8 p refs
(Contract W-7405-ENG-36)
(LA-4027-MS) Avail: CFSTI

Basic characteristics of two LiF thermoluminescent dosimeter (TLD) systems are presented. They include photon exposure response for miniature and 0.5-mm Teflon disc TLD's, in-air photon energy response for miniature and 0.5-mm Teflon disc TLD's, photon energy response for 0.5-mm Teflon disc TLD's packaged in rubber finger rings, heater current response for 0.5-mm Teflon disc TLD's, and source-to-detector distance response for a miniature ^{6}LiF, 10-in. polyethylene sphere system. Author (NSA)

N69-22533*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL RESEARCH SATELLITE-18 DATA REDUCTION AND ANALYSIS. VOLUME 1: SATELLITE DESCRIPTION AND OPERATIONS Terminal Flight Report
Laurence E. Peterson (Calif. Univ., San Diego), Duane Gruber (Calif. Univ., San Diego), Stephen J. Lewis (Calif. Univ., San Diego), Michael R. Stone (Calif. Univ., San Diego) and James I. Vette Jul. 1968 67 p refs Prepared by Calif. Univ., San Diego
(Contract F04701-68-C-0108)
(NASA-TM-X-61599; AD-678920; UCSD-SP-68-5-vol-1) Avail: CFSTI CSCL 18/4

The 17.2 lb. Environmental Research Satellite-18 (ORS-III-B) carried a set of five radiation detectors designed to measure charged particles, X-rays, gamma rays, and cosmic rays in the near Earth environment. Author (TAB)

N69-22537# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PYROMETER FOR MEASURING TEMPERATURES BELOW 800 C
A. V. Kogan and M. I. Bantsur Jun. 1968 10 p refs Transl. into ENGLISH from Poroshkovaya Met (USSR), v. 6, no. 7, 1966 p 102-106
(AD-682170; FTD-HT-23-113-68) Avail: CFSTI CSCL 14/2

A new type of pyrometer with a disappearing filament, especially adapted for determining temperatures below 800 deg C, is proposed. The new pyrometer contains all the essential parts of an ordinary instrument, but their arrangement is quite different. The objective creates an image of the body whose temp. is measured in the plane of a semitransparent prism. The bright filament is thus observed directly and the body in reflected light. The lower transparence of the prism decreases the apparent temp. of filament while its real temp. is unchanged. Experimental investigations with the new pyrometer show that the limit is about 480 deg. C. TAB

N69-22561# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ADC OF PULSE HEIGHT ANALYZER HAVING 8192 CHANNELS
E. G. Imaev et al 1968 15 p In RUSSIAN
(JINR-P13-3911) Avail: CFSTI

The analog-digital converter of pulse height analyzer having 8192 channels was described. The analyzer is used with a semiconductor detector for measuring gamma spectra over a wide range of energies. Author (NSA)

N69-22734# Oak Ridge National Lab., Tenn.
ON-LINE COMPUTER-CONTROLLED TRIPLE-AXIS NEUTRON SPECTROMETERS AT THE HFIR
M. K. Wilkinson, H. G. Smith, W. C. Koehler, R. M. Nicklow, and R. M. Moon *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 253–258 refs Sponsored by AEC (See N69-22710 11-24)
(SM-104/83) Avail: CFSTI

Two computer controlled triple-axis neutron spectrometers were constructed and installed at horizontal beam ports of the High Flux Isotope Reactor (HFIR). These spectrometers were designed to provide maximum flexibility for use in many different types of investigations. The monochromator cavity contains both a polarizing and a non-polarizing crystal, and since either crystal can be selected and accurately positioned by external controls, the spectrometers can be modified relatively quickly for experiments requiring either polarized or unpolarized neutrons. Each spectrometer is controlled on-line by its own computer, a programmed data processor-8 (PDP-8), through pulsed motors that drive up to six spectrometer axes. The advantages of this system lie in the flexibility of experiment control by stored programs on magnetic tape, which are brought into the fast memory when the conditions of the experiment dictate it. In addition to controlling the spectrometer, each computer has interfacing that allows control of auxiliary equipment such as shutters, velocity selectors, electromagnets, strip-chart recorders, and temperature controllers. Author

N69-22735# McMaster Univ., Hamilton (Ontario).
McMASTER UNIVERSITY NEUTRON CRYSTAL SPECTROMETERS
B. N. Brockhouse, G. A. de Wit, E. D. Hallman, and J. M. Rowe *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 259–270 refs (See N69-22710 11-24)
(SM-104/52) Avail: CFSTI

The spectrometers feature new design principles which at once greatly decrease cost and improve instrument flexibility. In particular, the angular ranges of most variables extend upwards of 145°. Extensive use is made of commercial machinists' rotary tables; these are available with accuracy of a few hundredths of a degree and a backlash of a tenth, at modest cost. Analyzing spectrometers employ two side-irradiated helium three counters mounted on arms ≈ 15 cm in length which move within cylindrical shielding. One counter records signal, the other background. Crystals are copper slabs, normally used in reflection from (200) or (220) planes. The mosaic spreads were increased by mechanical deformation. Extensive studies of different methods of deformation were made; the best appears to involve repeated bending and straightening of the crystal round a vertical radius (≈ 90 cm) at room temperature. Improvements in reflectivity by a factor of four, and integrated reflectivities of ≈ 10 minutes of arc have been obtained. The two instruments use the same original beam, one of them an unconventional multiple-axis spectrometer which offers the possibility of use of multiple analyzers. Borated water in iron tanks (protected by magnesium ingots) is used for shielding. Both spectrometers are fully automatic with all the usual capabilities. The control units employ IBM (0–24) card punches as card readers. Extremely simple logic permits complete nonlinear control of six independent variables, in one or two analyzing spectrometers. Author

N69-22736# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
THE BATTELLE NORTHWEST ROTATING CRYSTAL AND PHASED CHOPPER SLOW NEUTRON SPECTROMETER
O. K. Harling *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 271–279 refs (See N69-22710 11-24)
(Contract AT(45-1)-1830)
(SM-104/81) Avail: CFSTI

A hybrid spectrometer consisting of a phased chopper and rotating crystal is described. This system combines the advantages of a crystal monochromator with the time-of-flight method of analysing scattered neutron spectra. A coarse chopper, 80% transmission, is phased with the rotating crystal to provide suppression of order contamination and reflections off unwanted planes as well as a substantial reduction in background due to fast neutrons and incoherently scattered slow neutrons. The chopper can also be used to convert the spectrometer to a time-of-flight diffractometer. The monochromating section of this spectrometer permits the selection of neutron energies from ≈ 15 to ≈ 1000 meV. This wide range of operating energies is achieved with conservative operating conditions for the rotors which have functioned with high reliability. Burst widths at the sample positions of 8 to 12 μsec are obtained for typical operating conditions. Collimator angles from 0.08° to 1.75° are readily available. Copper and aluminium single crystals were used in the crystal rotors. These are usually oriented so that the 001 axis is the rotation axis. This orientation provides four reflections from the (200) or the (220) planes per revolution and permits use of even narrower spacing planes like the (240). Intensities are adequate for typical inelastic scattering experiments even at energies of ≈ 0.5 eV where most phase chopper systems cannot operate or do so with rather poor resolution. Author

N69-22737# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
THE CHALK RIVER ROTATING CRYSTAL SPECTROMETER
A. D. B. Woods, E. A. Glaser, and R. A. Cowley *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 281–288 refs (See N69-22710 11-24)
(SM-104/43) Avail: CFSTI

The most significant changes were (1) the replacement of the beryllium filter by a single crystal quartz filter to allow passage of the complete thermal spectrum, (2) the installation of a phased rotating collimator to eliminate higher order and other undesirable reflections, (3) the use of an axis of rotation of high symmetry of the rotating crystal to allow selection from a large variety of incident-neutron energies, (4) the use of a 2.5 cm diameter rotating crystal to improve resolution, (5) the replacement of the $^{10}BF_3$ neutron detectors by ^3He detectors to improve both resolution and intensity characteristics, and (6) the use of magnetic tape recording with a direct computer connection to improve the data handling. Under present operating conditions the apparent time-of-flight width of a small angle vanadium pattern for neutrons of incident wavelength 3.71 Å is about 36 μs compared with 76 μs obtained using 4.04 Å neutrons before these changes were made. Author

N69-22738# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
THE DOUBLE-CHOPPER NEUTRON SPECTROMETER AT ISPRA
K. Krebs *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 289–297 refs (See N69-22710 11-24)
(SM-104/130) Avail: CFSTI

The instrument was designed for use in solid and liquid state research. It consists of two phased triple-slotted rotor discs, both are made of heavy material (K-monel) and have a diameter of 29 cm. These rotors are able to reduce fast neutron and gamma radiation to such an extent that no filters or additional rotating collimators are needed. Each rotor is coupled to a reluctance motor driving unit by means of a thin flexible steel rod. The motor shaft of each driving unit runs on oil lubricated precision ball bearings. Rotor and driving motor are included within the same vacuum case so that no rotating seals are needed. The maximum operational speed was set to 22,000 rev/min corresponding to a safety factor of about 2 against yield stress in the rotor material. The width of

each curved fluted slot is 12 mm at one end and increases linearly to 33 mm at the other end. The a.c. motor of the first chopper unit is fed from a frequency generator which itself is driven by a frequency stabilized d.c. motor. The second chopper unit is driven by a pulsed d.c.–a.c. thyristor power converter, the pulsation frequency of which is derived from pick-up signals coming from the first unit. Thus there exists no connection at the power side between the two motors and beating problems are avoided. The phase angle between the chopper discs can be changed by shifting the control pulses coming from the first chopper. Author

N69-22740# Joint Inst. for Nuclear Research, Dubna (USSR).
THE SPECTROMETER FOR THERMAL-NEUTRON INELASTIC SCATTERING STUDIES AT THE IBR PULSED REACTOR
E. Maliszewski, Izabela Sosnowska, and J. Sosnowski (Inst. for Nuclear Res., Poland) *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 313–321 refs (See N69-22710 11-24)
(SM-104/131) Avail: CFSTI

The design of the spectrometer for studies of inelastic coherent scattering of thermal neutrons by single crystals at the IBR reactor is described. A polychromatic pulse neutron beam is scattered by a single crystal sample and the energy of scattered neutrons is analysed by three analysing single crystals (for three different beams of scattered neutrons). The time-of-flight technique is used to measure the incident neutron energy. The spectrometer is adapted for simultaneous structure and lattice dynamics studies of solids. Special features of this spectrometer and its applications are discussed. Author

N69-22745# Technische Hochschule Munchen (West Germany).
A NEUTRON CRYSTAL SPECTROMETER WITH EXTREMELY HIGH ENERGY RESOLUTION
B. Alefeld, M. Birr, and A. Heidemann *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 381–386 refs (See N69-22710 11-24)
(SM-104/148) Avail: CFSTI

A neutron crystal spectrometer proposed by Maier–Leibnitz is described. At the end of a neutron guide tube the white neutron beam falls vertically on the planes of a silicon single crystal. One half of the backscattered monochromatic neutrons enters a total-reflecting conical tube of nickelled glass plates and is focused on the sample. The scattered neutrons fall vertically on the planes of the silicon analyzer crystal. This analyzer is built up of about 2000 small slices of silicon which are adjusted to the inner surface of a sphere. Due to the finite size of the sample and the inaccurate adjustment of the silicon analyzers, the neutrons are not ideally focused on the sample by the analyzer and a large amount of them pass beside the sample and enter a counter. The window of the counter is about 4 times larger than the sample. By Doppler-shifting or by changing the temperature of the monochromator the energy of the monochromatic neutrons can be varied. In this way a change of neutron energy can be measured. Two thirds of the spin-incoherent cross-section is connected with nuclear spin-flip scattering of neutrons, and changes of energy of the nuclear spin are compensated by the neutron. Author

N69-22746# Institute of Nuclear Research, Vienna (Austria).
A NEUTRON SPIN-FLIP CHOPPER FOR TIME-OF-FLIGHT MEASUREMENTS
H. Rauch, J. Harms, and H. Moldaschl *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 387–394 refs (See N69-22710 11-24)
(SM-104/150) Avail: CFSTI

The direction of neutron polarization with high efficiency can be changed by means of a resonance spin-flip device, when Co–Fe single crystals are used as polarizer and analyzer in a polarized neutron spectrometer. The neutron intensity reflected by the analyzer goes to a value close to zero when the spin-flip device is on. Switching the spin-flip device on the off periodically, a chopped, monochromatic and polarized neutron beam behind the analyzer is obtained. The duty cycle and the repetition rate of the neutron bursts can be determined electronically over a wide range resulting in higher repetition rates than obtained with mechanical choppers. Repetition rates up to 20 kc were used but this value can be further increased. The duty cycle can be adjusted electronically to any value < 1. For high repetition rates and favorable duty cycles the device yields a higher peak intensity and the same or an even better resolution than expensive two-chopper systems. The energy resolution is determined by the double crystal reflection. Other factors which influence the time resolution decrease as the time-of-flight. The neutron energy can be varied from about 60 meV to 5 meV by changing the Bragg position and the resonance parameters. The background was favorably low as the sample was not directly in line with the reactor beam tube. Author

N69-22747# Institutt for Atomenergi, Kjeller (Norway).
TIME-OF-FLIGHT SPECTROMETER USING AN ELECTRONIC CHOPPER FOR POLARIZED SLOW NEUTRONS
O. Steinsvoll and A. Virso *In* IAEA Neutron Inelastic Scattering Vol. 2 1968 p 395–405 refs (See N69-22710 11-24)
(SM-104/65) Avail: CFSTI

In a diffractometer for polarized slow neutrons, the neutron spin resonance method is ordinarily used for flipping the neutron polarization. By varying the magnetic field across the flipper coil it is possible to pulse the flipping device into or out of resonance at short intervals. One then obtains a continuous beam but with short periods of reversed neutron polarization. When this beam is reflected from a crystal by a polarization dependent scattering process (elastic or inelastic), one obtains short periods of increased neutron intensity which can be used for time of flight measurements of the scattered neutron energies. A time of flight spectrometer utilizing this principle was built and tested on spin wave and magneto-vibrational scattering from a single crystal of bcc iron. Author

N69-22748# Hungarian Academy of Sciences, Budapest.
CORRELATION-TYPE TIME-OF-FLIGHT SPECTROMETER WITH MAGNETICALLY CHOPPED POLARIZED NEUTRON BEAM
L. Pal, N. Kroo, P. Pellionisz, F. Szlavik, and I. Vizi *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 407–416 refs (See N69-22710 11-24)
(SM-104/6) Avail: CFSTI

The transfer function of a system, which is the conventional time of flight distribution function, is proportional to the cross-correlation function involving a random signal and the response of the system to it. An experiment using this technique is described. The chopped monoenergetic, polarized neutron beam is produced by a polarizer–analyzer Co(Fe) single-crystal system with a spin-flipper between the crystals. The flipper is switched off and on, following a binary pseudo-random sequence. Pulses from the detector are stored in the first half of the memory of a conventional multichannel analyzer. At the end of the measurement, the cross correlation function is computed in a few seconds with the use of a special plug-in unit of the analyzer and stored in the form of decimal values in the second half of the memory. The neutron economy, the resolution, and the effect to background ratio of the correlation spectrometer are much better than in the conventional time of flight method. Author

N69-22749# Kernforschungszentrum, Karlsruhe (West Germany).
THE USE OF A PSEUDO-STATISTICAL CHOPPER FOR TIME-OF-FLIGHT MEASUREMENTS
F. Gompf, W. Reichardt, W. Glaeser, and K. H. Beckurts. *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 417–428 refs (See N69-22710 11-24)
(SM-104/67) Avail: CFSTI

A description of a statistical chopper is given, along with its method of measurement. The different influences on the accuracy of the measurements are discussed and compared to those in a conventional time of flight experiment. A few examples of pseudo-statistical experiments were simulated on a computer. It is shown that a statistical chopper is advantageous for time of flight spectra consisting of a number of peaks which are of main interest and have amplitudes greater than the average amplitudes of the spectra. Further, the method is advantageous in all cases where the background is very high. A preliminary experimental arrangement is described. Author

N69-22750# Gulf General Atomic, San Diego, Calif.
A NEW HIGH-EFFICIENCY TIME-OF-FLIGHT SYSTEM
J. F. Colwell, P. H. Miller, and W. L. Whittemore. *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 429–443 refs (See N69-22710 11-24)
(SM-104/77) Avail: CFSTI

To overcome the low efficiency with which the usual Fermi chopper time-of-flight system utilizes the available neutron source, a new system has been developed. Its principle is based on continuous beam modulation and depends for its success on special apparatus for the detection and manipulation of the data. In place of the singly pulsed beam produced by a Fermi chopper, a continuous train of pulses is produced by the new system. Several methods can be employed to derive the time-of-flight distribution f(t) for the scattering data. A convenient method has been to synthesize f(t) from the Fourier amplitudes and phases determined for an appropriate number of different impressed sinusoids. In another version, a chopper with progressively increasing slit and spacing widths gave results which were successfully analyzed by a standard auto-correlation technique. Extensive analyses of the relative accuracy with which the scattering pattern f(t) can be determined with the new and conventional systems were performed. For a small bump in the valley between two enormous peaks, the conventional system may be preferred. However, for the large number of experimental cases involving a number of relatively narrow peaks, the increase in accuracy in terms of signal to noise is proportional to the ratio of duty cycles for the two chopper systems. Author

N69-22758# McDonnell-Douglas Co., Huntington Beach, Calif. Missile and Space Systems Div.
GAUGE CALIBRATION AT EXTREMELY LOW PRESSURES
Lyle E. Bergquist 20 Apr. 1968 14 p refs Presented at 4th Intern. Vacuum Congr., Manchester, England, 17–20 Apr. 1968
(Douglas Paper 4776) Avail: Issuing Activity

Extremely low pressure gauges were calibrated. An inner chamber which is unbaked but cooled was used for the instrumentation enclosure. A quadrupole gas analyzer and an electron beam gun was used to reduce the thermally desorbed ions generating from the ionizational regional surfaces of the quadrupole. A known flow of calibrating gas is allowed into the guard vacuum and an equilibrium pressure is achieved. The calibrating gas level is measured in the inner chamber and the sticking coefficient for hydrogen is found. Author

N69-22770# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
MICRO X-RAY DEVICE [MICRODISPOSITIVO DE RAYOS X]
Carlos A. Canniatraci, Alfredo Karpeles, and Elma A. A. Terreyra 1968 20 p refs In SPANISH
(CNEA-218) AEC Depository Libraries

The characteristics and applications of a micro X-ray device applicable for intracavity exposure measurements are presented. The radiation source is a sealed capsule containing ^{125}I. The method for obtaining a source of ^{125}I by electrodeposition on silver is described. The microdevice is a portable unit whose operation does not depend on the supply of electric energy being sufficiently small to permit its intracavity placement. Radiographs obtained with the unit in the oral cavity, the nasopharynx, and the external auditory meatus were presented and possible applications of the unit in radiotherapy and radiodiagnostics were suggested. The intracavity placement of the radiation unit reduces, and in many cases eliminates, the superposition of structure in the radiographic image. The use of specially designed collimators makes it possible to obtain a very fine beam of X-rays, increasing the resolution in some cases. Author (NSA

N69-22791# Atomic Energy Commission Research Establishment, Riso (Denmark).
DEVELOPMENT OF TEMPERATURE- AND CONDUCTIVITY-COMPENSATED IMPEDANCE VOID DETECTOR
Dan S. Nielsen Aug. 1968 37 p refs
(RISO-M-785) Avail: AEC Depository Libraries

A temperature- and conductivity-compensated impedance void detector which provides a means of measuring local void fractions in two-phase flow under subcooled-boiling conditions has been developed. Details of the design and operation of the detector are presented with out-pile and in-pile results. Author (NSA)

N69-22825# Bhabha Atomic Research Centre, Bombay (India).
DESIGN OF PROTON RECOIL COUNTERS WITH MULTIPLE RADIATORS
G. Muthukrishnan, K. B. S. Murthy, and C. M. Sunta 1968 24 p refs
(BARC-330) Avail: AEC Depository Libraries

Two types of counters for fast neutron dosimetry and for neutron flux measurement were developed using a proportional counter with multiple proton radiators. Calculations were made for the counter response using CDC 3600–160A computer for polythene radiators of thickness varying from 0.01 mm to 3 mm and for incident neutron energies from 0.3 to 16 MeV. These computations along with that of the burshane gas response were used to select the pressure of the gas, thickness of the solid radiators and the proportions of their areas such that the overall response of the counter is as close to the desired response as possible. The energy response of the counters was experimentally studied using monoenergetic neutrons. The experimental and the calculated responses were in good agreement. Author (NSA)

N69-22858# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
THE CADMIUM SULPHIDE HIGH-LEVEL GAMMA EXPOSURE RATE METER, TYPE BP4
W. H. R. Hudd Jul. 1968 34 p
(RD/B/N-1108) Avail: CFSTI

A high level gamma exposure rate instrument using a cadmium sulphide crystal detector was developed. The detector is small and

may be mounted either on a telescope arm attached to the instrument or on a long connecting lead for monitoring otherwise inaccessible areas; it may be used over the temperature range 0 to 60°C. The detector characteristics were investigated in detail and the optimum operating conditions determined. Exposure rate is displayed on a logarithmic scale on a cirscale meter. The use of cadmium sulphide crystals outside the quoted ranges of exposure rates and temperatures was also investigated. NSA

N69-22881# Institut Franco-Allemand de Recherches, St. Louis (France).
VISUALIZATION OF GASEOUS MOBILE OBJECTS. CONTRIBUTION TO THE STUDY OF STRIOSCOPY AND HOLOGRAPHY APPLIED TO HYPERSONIC PHENOMENA IN WIND TUNNELS [VISUALISATION DES OBJECTS GAZEUX MOBILES. CONTRIBUTION A L ETUDE DE LA STRIOSCOPIE ET A DE L HOLOGRAPHIE APPLIQUEES AUX PHENOMENES HYPERSONIQUES DANS LES TUNNELS DE TIR]
P. Smigielski 1969 12 p refs In FRENCH
(Contract DRME-232/68)
(ISL-2/69) Avail: CFSTI

The possibilities of Schlieren photography and holography for the visualization of gaseous mobile objects a little out of phase are studied in terms of applications to the wakes of hypersonic engines in a low pressure atmosphere. Several modifications of Schlieren systems are proposed to increase their sensitivity. A method of quantitative Schlieren usage is studied. This research has led to the examination of different parameters influencing the quality and sensitivity of the double knife and double passage system utilized on light gas guns. Holograms of hypersonic projectiles were obtained by shadowgraph photography, Schlieren photography, and differential interferometry in polarized light. The quality and the brillance of the images given by the cineholographic system are analyzed. Transl. by P.A.B.

N69-22884# Gesellschaft fuer Kernverfahrenstechnik m.b.H., Juelich (West Germany).
CALCULATION OF THE CRITICAL SPEEDS OF MULTISECTION ROTORS OF HIGH-SPEED ROTATING MACHINERY [DIE BERECHNUNG DER KRITISCHEN DREHZAHLEN VON MERGLIEDRIGEN ROTOREN SCHNELLAUFENDER MASCHINEN]
P. Weidner and G. Zippe Jul. 1968 26 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-68-28) Avail: AEC Depository Libraries

The critical speeds of elastically coupled chains of gyroscopes are mathematically treated. The equations of motion are formulated as Lagrange's equations; the critical frequencies result from the characteristic determinant of the system. Longitudinal vibrations and elastic coupling of the ends are taken into account. Friction and gravity forces are neglected. The transition to the homogeneous shaft is included. Author (NSA)

N69-22930*# Michigan Univ., Ann Arbor.
A LABORATORY AND DESIGN STUDY OF THE EXPERIMENTS FOR A SMALL AERONOMY SATELLITE Final Report
Jul. 1968 103 p
(Contract NASr-54(13))
(NASA-CR-100586; Rept-08235-1-F) Avail: CFSTI CSCL 14B

Results of the investigation on the behavior of a mass spectrometer oscillating slowly with respect to the orbital path vector and the corollary question of whether or not the composition results obtained from spectrometers in this situation could be used to measure ambient temperature are presented. An experimental approach was proposed to determine the effect of outgassing and of gas–surface interactions of the input surfaces of mass spectrometers on the performance and errors of these instruments; it required the acquisition of a laboratory mass spectrometer and a modern vacuum system capable of 10^{-11} torr. The vacuum system is a Varian ion and sublimation pump with sorption cryogenic forepump. As part of the general work with mass spectrometers, a low power ion source was developed and this is briefly described. The motion of a three body satellite was analyzed under the action of gravitational and magnetic torques. Three methods for measuring electron density were developed for possible use on a small satellite. These employed the measurement of transmission between two antennas, the impedence of a single antenna, and the resonance relaxation of the ambient plasma. The methods were flown on Aerobee 4.207 VA on 8 August 1967 and all worked successfully. Author

N69-22950# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PRACTICAL GUIDE TO DOSIMETRY AS APPLIED IN THE RESEARCH REACTORS OF THE SACLAY AND GRENOBLE NUCLEAR RESEARCH CENTERS [GUIDE PRATIQUE DE LA DOSIMETRIE MISE EN OEUVRE DANS LES REACTEURS DE RECHERCHE DU C.E.N./G ET DU C.E.N./S]
Jun. 1968 63 p refs In FRENCH
(CEA-R-3423) Avail: CFSTI

Since the problems concerning neutron and gamma flux measurements which arise during irradiation experiments in the reactors in the Grenoble and Saclay Centres are of the same type, and since the solutions found are very often adopted in common, it is attempted to describe the methods used at the present time. A brief description is given of the production of the detectors and the electronic apparatus. The formula usually used for the interpretation of the measurements are given. A series of technical data cards gives the most commonly used detector characteristics. These cards give the physical characteristics of the detectors, their nuclear constants, if any, the most suitable counting methods, and the field of application. Author (NSA)

N69-22985# British Steel Corp., London (England). Metallurgy Div.
A LINEAR DISPLACEMENT GAUGE FOR USE IN FRACTURE TOUGHNESS TESTING Basra Open Report
M. J. May and E. F. Walker 16 Nov. 1967 8 p refs
(PB-180454; MG/E/308/67) Avail: CFSTI

A sensitive, highly linear clip gauge, better known as a double cantilever displacement gauge, has been designed and proved extremely reliable for use in plane strain fracture toughness testing. The gauge is designed to give rigid location of the strained ligaments across the crack so as to ensure measurement stability, combined with a high degree of linearity and maximum sensitivity for use with an autographic plotting table. By selection of suitable strain gauges, this design of clip gauge may be used at cryogenic and elevated temperatures. Author (USGRDR)

N69-23007# Czechoslovak Academy of Sciences, Prague. Nuclear Research Inst.
A GLASS THERMOLUMINESCENT DOSIMETER
Z. Spurny *In AEC* 2d Intern. Conf. on Luminescence Dosimetry [1968] p 18-26 refs (See N69-23005 11-06)
Avail: CFSTI

A thermoluminescent dosimeter (TLD) system, in which the phosphor is made of aluminophosphate manganese-activated glass, is described. The main properties were investigated, including

chemical composition, the effective atomic number and corresponding energy response, the emission spectra and other optical properties, glow curve fading, EPR spectra, and electrical conductivity. The relative sensitivity in comparison with other TLD phosphors was established. The commercial prototype of dosimetry and reading apparatus is described, and the operational characteristics briefly summarized. The influence of neutron-neutron fluxes and the problem of fading are mentioned. Author

N69-23011# Harshaw Chemical Co., Cleveland, Ohio Crystal-Solid State Dept.

NEW SOLID LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETERS

F. Morgan Cox *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 61–77 refs (See N69-23005 11-06)
Avail: CFSTI

Several new types of solid extruded and high sensitivity LiF thermoluminescent dosimeters are described in technical detail. These dosimeters retain the desirable radiation detection properties of LiF powder, such as wide exposure measurements range, dose rate independence, essential energy independence, approximate tissue equivalence and long term response retention. In addition, they have other useful properties, not present in the powder, including optical transparency, reusability, mechanical ruggedness, and handling convenience. Range of measuring sensitivity is mainly a function of the mass of the dosimeter. Dosimeter types range in size from 0.25 inch by 0.25 inch by 0.035 inch ribbons for personnel dosimetry applications to 0.5 millimeter diameter by 6 millimeter rods for criticality dosimetry and radiation therapy applications. Author

N69-23012# Radiation Detection Co., Mountain View, Calif.

A UNIQUE THROWAY LiF DOSIMETER

Philip D. La Riviere *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 78–81 refs (See N69-23005 11-06)
Avail: CFSTI

A New LiF powder is described, suitable for dosimetry above 1R. The salient advantages over conventional LiF powder include reduced supralinearity, low cost, and availability in encapsulated form ready for use. Author

N69-23014# Atomic Energy Commission Research Establishment, Riso (Denmark).

MANGANESE-ACTIVATED LITHIUM-BORATE CRYSTALS, GLASSES AND SINTERED PELLETS AS THERMOLUMINESCENCE DOSIMETERS

Paul Christensen *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 90–117 refs (See N69-23005 11-06)
Avail: CFSTI

From the system Li_2O-B_2O_3-B_2O_3, compounds with Li_2O:B_2O_3 ratios of 1:1, 1:2, 1:3, and 1:4, activated by manganese, were prepared and investigated for thermoluminescence. In addition to the normally reported lithium tetraborate with glow peaks at approximately 60°C and 220–240°C if a heating rate of 22°C per second is used, a new useful Li_2O·$3B_2O_3$ phosphor with a glow peak at approximately 190° was prepared. Solid dosimeters of lithium borate were prepared either as glasses with thicknesses down to 20 mg/cm^2 or as sintered pellets with thicknesses down to 75 mg/cm^2. A study of their utility as practical thermoluminescence dosimeters is reported. Author

N69-23015# Royal Postgraduate Medical School of London Univ. (England). Dept. of Medical Physics.

THE PROPERTIES OF LITHIUM POWDER AS A SOLID STATE DOSIMETER

C. A. Jayechandran, M. West, and E. Shuttleworth *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 118–138 refs (See N69-23005 11-06)
Avail: CFSTI

The effect of varying some of the parameters involved in the production of lithium borate is described, with special reference to both the firing time of the molten lithium borate at 950°C and to its rate of cooling. The most useful dosimetry material was obtained by allowing the melt to cool on the bench after fusing the lithium borate for about 15 minutes. Increasing the concentration of manganese to 0.1% or 0.34% by weight improves both the sensitivity of the phosphor and its response to low energy photons. The material is cheap and easy to make. The emission spectrum for lithium borate peaks at about 6,000 Å, compared with 4,200 Å for lithium fluoride. The main dosimetry peak has two components. Their relative response varies with dose and with photon energy, producing a supralinearity in dose response which is energy dependent. The supralinearity increases with photon energy. Lithium borate samples can be made to have a response to low energy X-rays which matched that of air, water, or tissue. Author

N69-23019# Physikalisch-Technische Bundersanstalt Brunswick (West Germany).

DOSIMETRY WITH EXO-ELECTRONS

J. Kramer *In AEC* 2d Intern. Conf. on Luminescence Dosimetry [1968] p 180–199 (See N69-23005 11-06)
Avail: CFSTI

Cold light and cold electrons, meaning luminescence and exoelectron emission, are two aspects of the same kind of procedures in solids. As with luminescence, exoelectron emission can be used for dosimetry of ionizing radiation. Forms and features of exo-dosimeters, their sensitivity, their measuring range, and apparatus for evaluation are described. Doses between 10^{-6} and 10^{+7} can be measured; an extension to smaller and higher doses is possible. Author

N69-23020# Oak Ridge National Lab., Tenn. Health Physics Div.

SOME STUDIES ON RADIATION DOSIMETRY BY THERMALLY STIMULATED EXOELECTRON EMISSION (TSEE)

K. Becker *In AEC* 2d Intern. Conf. on Luminescence Dosimetry [1968] p 200–219 refs (See N69-23005 11-06)
Avail: CFSTI

Results concerning the dosimetric properties of several low-Z (LiF, $Li_2B_4O_7$, BeO) and high-Z ($CaSO_4$, $SrSO_4$, $BaSO_4$, CaF_2) TSEE detectors are summarized. The reading instrument and detector preparation techniques are briefly described. Different factors affecting the shape of the TSEE spectrum, such as the linear energy transfer of the radiation, and the sensitivity and energy response of the materials are discussed. Dosimeters consisting of mixtures of suitable detectors offer advantages, such as the possible reading of interval dose measurements and accumulation of integral doses. Fast neutron dosimetry is possible by the use of recoil proton radiators. It is concluded that TSEE detectors have a number of advantages over other solid state dosimeters. In particular, they can be made more sensitive, have a sensitive thickness of less than 100 Å, and are simpler to prepare. Fading is only a problem in intense light or if the TSEE occurs below about 150° to 200°C. Author

N69-23023# Oxford Univ. (England). Research Lab. for Archaeology.

A PHOTON-RATEMETER SYSTEM FOR LOW-LEVEL THERMOLUMINESCENCE MEASUREMENTS

M. J. Aitken, J. C. Alldred, and J. Thompson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 248–285 refs (See N69-23005 11-06)
Avail: CFSTI

A system is described in which the signal is taken from the photomultiplier anode in the form of pulses corresponding to the arrival of individual photons at the photocathode. After amplification, these pulses are fed through a pulse height discriminator to a ratemeter; the output of this is applied to the Y-axis of a coordinate plotter which displays the glow curve in the conventional way. Using a 44 mm diameter bialkali photocathode, a dark count rate of less than 100 c/s is obtained, without cooling; this is equivalent to a light level that is less than half the level corresponding to the dark current in a conventional dc system. There are also worthwhile reductions in the noise associated with the dark signal and with weak light signals. A measurement of this type can be converted into absolute light intensity without knowledge of the photomultiplier amplification factor; this vastly facilitates comparisons between different systems. Because of the finite discriminator level, the observed count rate is affected by variations in the high voltage supply and in the amplifier gain, but to a much smaller degree than in conventional systems. In an investigation of whether the photons being measured are in fact emitted as statistically single events rather than in time correlated groups, no evidence for the latter was found in either radiothermoluminescence or various types of non-radiation induced thermoluminescence. Author

N69-23024# Oxford Univ. (England). Research Lab. for Archaeology.
THE COLOUR OF SPURIOUS THERMOLUMINESCENCE IN DOSIMETRY PHOSPHORS
S. J. Fleming *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 266–280 refs (See N69-23005 11-06)
Avail: CFSTI

At low radiation levels of the order of 100 microrads, the measurement of the dosimeter peak of phosphors such as LiF and CaF_2 is limited by the magniturde of an additional thermoluminescent peak which is not induced by radiation, and which is termed spurious. The color of this spurious light was studied and compared to the emission spectrum of the phosphor's dosimeter peak. High accuracy of measurement was obtained over the wavelength region of 4000 to 6300 Å (despite the considerable variability of the spurious light level from sample to sample of as much as 70%), by use of a twin photomultiplier system. One photomultiplier was used in conjunction with interference filters to measure the spectrum of emission; the other photomultiplier was used as a monitor of the total amount of spurious light being given out by each sample. The samples were prepared as fine grain deposits on aluminum discs to obtain a uniform flat sample surface, while taking advantage of the much enhanced spurious level produced by use of smaller grains. The results are compared with those published by other workers. Suggestions are made for optimization of the detector system for measurement of the radiation-induced thermoluminescence at low levels. Author

N69-23025# Oxford Univ. (England). Research Lab. for Archaeology.
LOW-LEVEL ENVIRONMENTAL RADIATION MEASUREMENTS USING NATURAL CALCIUM FLUORIDE
M. J. Aitken *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 281–290 refs (See N69-23005 11-06)
Avail: CFSTI

Two techniques are described for reducing background levels of thermoluminescence so that the minimum dose detectable with natural calcium fluoride in loose powder form can be reduced to about five microrads. Spurious thermoluminescence can be quenched by an order of magnitude by using oxy-free nitrogen for readout and by prior washing in domestic water softener. Light-induced thermoluminescence sensitivity can be almost eliminated by heating for a few minutes at 685° C to drain the deep traps responsible for the light transfer mechanism; this is also done in an atmosphere of oxy-free nitrogen. The minimum dose rate that can be measured is limited by radioactive impurities in the calcium fluoride itself. The self dose rate of the standard material is estimated from analysis to be between 8 and 12 millirads per year; this was confirmed by measurements. Field experiments were made to measure the variation of cosmic ray dose with depth in the ground; the dose at the surface is higher than the dose at a depth of four feet by a factor of 1.75. Application of the technique to measurement of environmental dose rates on archaeological sites is described; the results are compared with the estimates obtained from measurement of the radioactive content of relevant soil samples.

N69-23032# Pennsylvania Univ., Philadelphia. Dept. of Radiology.
SUPRALINEARITY IN LiF
Peter Bloch *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 341–352 refs (See N69-23005 11-06)
(Grants PHS RH-0043; PHS 4TI-RH-50-0252)
Avail: CFSTI

In postulated descriptions of the supralinear effect, an implicit assumption is made that the spectral output of the thermoluminescent material is the same at low and high absorbed doses. Small spectral changes during thermoluminescence could, however, be important since the quantum efficiency of the photomultiplier cathode strongly depends on the wavelength of light. Thus small changes in the spectral distribution of the thermoluminescence light with absorbed dose would lead to a nonlinear response of the detecting system. To test this possibility, the optical spectrum from the LiF dosimeter was split using a dichroic filter, which transmits wavelengths longer than 450 nm and reflects shorter wavelengths. Two photomultipliers were used to measure the thermoluminescent light: one arranged to record the transmitted light and the other the reflected light. With this detecting system it was found that the luminescent output from LiF tends toward longer wavelengths with increased 60°Co exposure. Author

N69-23033# Lund Univ. (Sweden). Dept. of Radiation Physics.
INDUCED LET-DEPENDENCE IN THERMOLUMINESCENT LiF AND ITS APPLICATION AS LET-METER
Carl A. Carlsson and Gudrun Alm Carlsson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 353–363 refs (See N69-23005 11-06)
Avail: CFSTI

The sensitivity of thermoluminescent LiF for different radiation qualities was investigated as a function of radiation history. LiF-dosimeters which were pre-irradiated with large doses showed after an appropriate annealing an increased sensitivity for small doses (test doses). This increase was more pronounced the lower the LET of the test dose. A number of radiation qualities, covering a wide LET-range, was used for both pre-irradiation and test dose. With each pre-irradiation quality several radiation qualities were used as test doses. A pair of LiF-dosimeters, one sensitized and one unsensitized, is proposed and investigated as a LET-meter. The proposed LET-meter shows a promising resolution power for radiation qualities with a dose average LET like that of 30 to 500 keV photons. With such a LET-meter preliminary measurements indicated the changes in LET with increasing depth of incident high energy electrons. Author

N69-23038# Stanford Univ., Calif. Dept. of Radiology.
INTERCOMPARISON OF THE FRICKE CHEMICAL, THE LiF THERMOLUMINESCENT AND AIR IONIZATION DOSIMETERS FOR 6 MV, 250 KVCP AND 60 KVP X-RAYS

C. J. Karzmark and Janet Geisselsoder *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 400–409 refs (See N69-23005 11-06)
(Contract AT(04-3)-328-PA-4)
Avail: CFSTI

An intercomparison was made between three dosimetry systems using three wide differing x-ray qualities. The radiations used were: 6 MV X-rays produced by a linear accelerator; 250 KVCP X-rays, 3.0 mm Cu HVL; and 50 KVP X-rays, 0.21 mm Al HVL. Air ionization was measured with a plane parallel extrapolation chamber. The Fricke chemical and LiF thermoluminescent dosimeters were exposed to these beams inside the chamber to ensure identical geometry. A $G_{Fe}+++$ value of 15.6 ions/100 eV was assumed for 6 MV X-rays and the response of LiF is evaluated in terms of rads in water. For the other beams, a $G_{Fe}+++$ value was derived from ionization measurements and LiF response expressed as a function of rads in water as determined by the Fricke dosimeter. For X-rays of 250 KVCP and 50 KVP, the $G_{Fe}+++$ values derived are 14.9 and 14.6 ions/100 eV respectively. An anomalously high response of LiF to 50 KVP radiation was found. For this beam, effective energy 12 KeV, and increase in LiF response of almost 100 per cent was observed. Author

N69-23038*# California Univ., Berkeley. Lawrence Radiation Lab.
THE QUALITY AND LET DEPENDENCE OF THREE THERMOLUMINESCENT DOSIMETERS AND THEIR POTENTIAL USE AS SECONDARY STANDARDS
E. Tochilin (Naval Radiol. Defense Lab.), N. Goldstein (Naval Radiol. Defense Lab.), and J. T. Lyman *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 424–437 refs Sponsored jointly by Defense Atomic Support Agency, NASA, and AEC (See N69-23005 11-06)
Avail: CFSTI CSCL 14B

The energy dependence of thermoluminescent LiF, $Li_2B_4O_7$:Mn, and BeO dosimeters was investigated over a range of x- and γ-ray energies extending from 6 to 2750 keV. Radiation sources included filtered x rays and isotopes emitting γ rays of known energies. In order to correlate the energy deposited in the phosphor with light output the measured response was compared with the computed value of absorbed dose. A systematic increase in light output with decreasing photon energy was observed for all phosphors: this was interpreted as an LET effect. The LET dependence of these phosphors was then investigated with accelerator-produced charged particles for LET values from 0.25 keV/μ to beyond 1000 keV/μ. Response curves are presented which allows the use of LiF and $Li_2B_4O_7$:Mn as secondary standards to measure absorbed dose or exposure. The use of this method for x- and γ-ray measurements down to 6 keV is described. Calibration is by means of a ^{60}Co γ-ray standard. Author

N69-23039# Texas Nuclear Corp., Austin.
THE RESPONSE OF THERMOLUMINESCENT DOSIMETERS TO PROTONS WITH ENERGIES TO 137 MeV
C. Warren Parker, Jr., Kenneth R. Blake, and John B. Nelson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 438–455 refs (See N69-23005 11-06)
(Contract AF41(609)-3096-2)
Avail: CFSTI

Several varieties of thermoluminescent dosimeters of both the LiF and CaF_2:Mn types were exposed to protons with energies from 5 MeV to 137 MeV. The response per unit proton fluence of these dosimeters was measured as a function of proton energy. These measurements were found to agree with calculated response curves based on the energy absorbed in the dosimeter. Measurements were also made to determine the linearity of the response as a function of absorbed surface dose in tissue at 31 and 100 MeV. These results agree with those obtained effect of dose rate was measured at an energy of 31.3 MeV and the response of the dosimeters was found to be independent of dose rate in the range from 0.33 rad per sec to 67 rad per sec. Author

N69-23043# Oak Ridge National Lab., Tenn. Health Physics Div.
LET EFFECTS ON THE RADIOPHOTOLUMINESCENCE IN SILVER-ACTIVATED DOSIMETER GLASSES
K. Becker and J. S. Cheka *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 501–517 refs (See N69-23005 11-06)
Avail: CFSTI

High LET radiation creates somewhat different radiophotoluminescence (RPL) centers in silver-activated glasses than low LET electrons. The RPL emission spectra of several glasses irradiated with thermal neutrons, in particular of a new lithium borate glass, have been found to be different from the ones in gamma irradiated glasses. During a stabilizing heat treatment, the shape of the spectrum changes in such glasses. In other commercial and experimental glasses, the differences are less pronounced. In these glasses the build-up and fading kinetics of the RPL may also depend on LET: the gamma induced RPL is initially more stable than the thermal neutron induced RPL, but the residual RPL after prolonged fading can be higher after thermal neutron irradiation. Glasses which exhibit little LET dependence of their RPL spectra also are less different in the radiation induced absorption spectra than the glasses with a high LET dependance of the RPL. Author

N69-23044# Gesellschaft fuer Strahlenforschung m.b.H., Munich (West Germany).
DIFFERENCES OF GAMMA AND NEUTRON INDUCED RADIOPHOTOLUMINESCENCE SPECTRA OF PHOSPHATE GLASS DOSIMETERS
D. F. Regulla *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 518–524 refs (See N69-23005 11-06)
Avail: CFSTI

Fluorometric measurements of ultraviolet excited radiophotoluminescence of usual phosphate glasses yield different shapes of fluorescence spectra after gamma and neutron irradiation. Gamma radiation induces a broad simply built fluorescence band with a maximum at about 600 nm, while after neutron irradiation an additional less pronounced maximum is found at about 480 nm. The results are reported and discussed. Author

N69-23052# New York Univ., N. Y. Medical Center.
INITIAL FADING CHARACTERISTICS OF LiF-TEFLON MICRORODS
C. G. Orton and E. Buesmann *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 632–638 refs (See N69-23005 11-06)
Avail: CFSTI

Significant fading occurs with Conrad Type 7 LiF microrods during the first few hours of storage at room temperature after irradiation. Graphical analysis shows that this fading can be represented as the exponential decay of 3 separate components with half-lives of 1.0 min., 4.2 min., and 34 min. Experiments at 0°C show that this instability does not, however, appear to obey simple 1st order trap decay kinetics. The elimination of early fading by post-irradiation annealing for 15 mins. at 80°C is possible though inconvenient. Pre-irradiation annealing for 24 hours at 80°C does not eliminate the instability. Author

N69-23053# Atomic Energy Commission Research Establishment, Risø (Denmark).
A VERSATILE AUTOMATIC SAMPLE CHANGER FOR READING OF THERMOLUMINESCENCE DOSIMETERS AND PHOSPHORS
Lars Boetter-Jensen and P. Bechmann (Copenhagen Univ.) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 640–651 refs (See N69-23005 11-06)
Avail: CFSTI

The TL-reader to be described is a modified model of the reader described in an earlier report. The electronic part was completely changed, and a peak reading facility was constructed for registration of the glow peak amplitudes. The instrument has a capacity of twelve samples and is provided with a compensating system for the black-body radiation. A description is given of the performance of the instrument and of measurements carried out to demonstrate the compensating effect in comparison with measurements in which the black-body radiation was reduced with an optical filter. Author

N69-23054# California Univ., Livermore. Lawrence Radiation Lab.
HOT NITROGEN GAS FOR HEATING THERMOLUMINESCENT DOSIMETERS
K. F. Petrock and D. E. Jones *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 652–669 refs (See N69-23005 11-06)
Avail: CFSTI

Improvements are described in TLD reader design, especially the use of hot nitrogen gas for the heating of TLD phosphors. The reader reads 80 extruded LiF rods over a dynamic range of 3 mR to 1000 R in 40 min or less. The improved electronics gives a digital light sum and can simultaneously give digital glow curves for all except the minimum doses. The hot-gas heating technique was found to have some excellent characteristics: (1) it is very efficient, (2) it gives a low thermal glow and there is no heater pan to change in emissivity or reflectivity, and (3) the background thermal glow is nearly constant throughout the reading cycle. With this system, the photomultiplier tube dark current and part of the thermal glow can be biased out so that a minimum signal is seen from an undosed detector. Thus, the system can automatically sense whether a dosimeter enters the readout chamber and is heated properly; no added electronic complication is necessary and there is no appreciable effect upon dynamic range. This may be useful to establish evidence of proper operation of a TLD system for personnel monitoring records. Author

N69-23055# Argonne National Lab., Ill. Radiological Physics Div.
ELECTRO-OPTICAL TECHNIQUES FOR ULTRASENSITIVE RADIOPHOTOLUMINESCENT DOSIMETRY
J. Kastner, R. K. Langs, B. A. Cameron, M. Paesler, and G. Anderson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 670–676 refs (See N69-23005 11-06)
Avail: CFSTI

A microdosimetric system was conceived and investigated which is potentially capable of sensing extremely low radiation dosages (in the order of microrads). This system depends on the little-known fact that the decay time for the visible luminescence, which is a measure of the absorbed dose, is at least ten times longer than the decay of the indistinguishable visible fluorescence (to UV) which is an inherent characteristic of unexposed silver phosphate glasses. In the hope of simplifying the reader, experiments were carried out using an electro-optical Pockels shutter and much cheaper and less complex UV sources. Author

N69-23056# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
PREDOSE AND SENSITIVITY OF RADIOPHOTOLUMINESCENT GLASSES FLUCTUATIONS IN MEASUREMENT: A NEW METHOD OF CALIBRATION
Anne-Marie Chapuis, Henri Francois, and Monique Pichoret-Chartier *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 677–688 refs (See N69-23005 11-06)
Avail: CFSTI

A new method of calibration was formulated which defines the characteristics of the reader for each series of measurements carried out. Modification of existing procedures was necessary due to problems encountered in conducting successive irradiation on the same dosimeter under low dosage conditions delivered over periods on the order of several months. Using the new method, it is demonstrated that measurements can be made on the same apparatus with adjustments and geometry that are exactly the same. A computer subroutine was also written which, along with the characteristics of the calibration glasses, gives those of the meter, thus allowing calculation of errors in dose measurement in order to estimate the degree of precision obtained. Author

N69-23057# Air Force Systems Command, Wright-Patterson AFB, Ohio. Metallurgy and Ceramics Research Lab.
APPARATUS FOR THERMOLUMINESCENCE MEASUREMENTS
P. L. Land and E. D. Wysong *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 689–704 refs (See N69-23005 11-06)
Avail: CFSTI

A versatile, variable temperature, rotatable optical cryostat was developed, with housing and associated equipment mounted on an optical bench for convenient alignment. Either a liquid nitrogen or liquid helium dewar may be used with the housing, including features such as a teflon bearing on which the supporting surfaces of the dewars turn and threaded window ports for ease in coupling to the various associated apparatus. Hand winding and potting of heaters in sample holders and the choice of adhesives for sample mounting are discussed in detail, as well as a simple and inexpensive means of achieving an approximately linear heating rate for measurements where the control function is provided by a resistance network containing thermistors. A low resolution, rapid scan spectrometer is also used to permit dramatic resolution and characterization of low peaks resulting from traps having nearly the same activation energy and to provide the emission spectrum at any temperature during the glow. When prominent line emission is detected, further resolution is achieved with a grating spectrometer. The filter wheel is also a convenient mechanism for polarization studies. Author

N69-23058# Harshaw Chemical Co., Cleveland, Ohio. Crystal-Solid State Dept.
THE HARSHAW MODEL 2000 THERMOLUMINESCENCE ANALYZER
J. B. Richey and R. W. Carlson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 705–719 refs (See N69-23005 11-06)
Avail: CFSTI

An instrument for use in analytical and personnel dosimetry and nuclear medicine was developed which incorporates the flexibility required for analytical studies, as well as the stability and ease of operation needed for large scale personnel applications. The basic range using solid or powdered lithium fluoride is several mR to 10^5R; with more sensitive calcium fluoride, mR fractions were measured. The analyzer is comprised of two components: a thermoluminescence detector and an automatic integrating

picoammeter. A detailed description of the system is presented; this includes several of its unique features, such as a thermoelectrically cooled, temperature stabilized photomultiplier tube and thermocouple feedback control of heater temperature to provide linear heating rates for flow curve analysis. Author

N69-23060# Stanford Univ., Calif. Linear Accelerator Center.
USE OF THERMOLUMINESCENT DOSIMETERS IN HIGH ENERGY HEALTH PHYSICS
G. K. Svensson, R. C. McCall, T. M. Jenkins, and W. R. Nelson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 737–750 refs (See N69-23005 11-06)
Avail: CFSTI

The use of thermoluminescent dosimeters around a 20 GeV electron accelerator is discussed. Advantages over other types of dosimeters, problems of calibration and interpretation of results, and fabrication techniques are described. Application to the measurement of electromagnetic showers, electron and muon scattering, bremsstrahlung distributions, beam profiles, etc., are presented. Author

N69-23061# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Health Physics Branch.
A THERMOLUMINESCENCE DOSIMETRY SYSTEM BASED ON EXTRUDED LITHIUM FLUORIDE DOSIMETERS
A. R. Jones *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 751–772 refs (See N69-23005 11-06)
Avail: CFSTI

Measurements on powdered, silicon encapsulated, single crystal, and extruded forms of lithium fluoride, which show that the extruded form is the most suitable for general purpose γ dosimetry due to its ease of use and reproducibility, are reported. Standard deviations in batches of 10 were measured. A holder incorporating a perforated tin filter was designed to protect the lithium fluoride against contamination, to provide electron equilibrium for high energy gamma rays, and to compensate for the low energy enhancement of sensitivity; energy and angular dependence data using this holder are included. In addition, as a step toward automation, a reader using a Harshaw heater was developed, which includes an analog to digital converter giving one output pulse per mR. The storage, display, and use of the pulse count in reading exposures of 1 to 1000 mR without the necessity of range changing is discussed in detail; and it is shown that this procedure, unlike one dependent upon a light source, calibrates and checks the entire system. Author

N69-23062# Tokyo Shibaura Electric Co., Ltd. (Japan). Central Research Lab.
BETA DOSIMETRY WITH SILVER-ACTIVATED PHOSPHATE GLASS
R. Yokota, Y. Muto, and T. Miyaka (Nippon Atomic Industry Group, Japan) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 773–782 refs (See N69-23005 11-06)
Avail: CFSTI

The design of a dosimeter glass and cell, as well as performance in the energy region below 2 MeV, is described in order to disprove reports that its low energy beta sensitivity is low. It was found that use of trapezoidal shape and a special handling cell enables fluorimeter measurement of 10 m rads of Tl 204 beta rays. In addition, the response versus average beta ray energy was obtained, and from two readings taken by the movement of the cell's slit, skin dose measurements using this single glass in its badge case with two different window materials were made. Smaller trapezoidal glass apparatus and corresponding badge case was also developed, the size of which allowed it to be conveniently used attached to the inner side of the forefinger. The two types of trapezoidal glass, when encased in badge cases with 12 mg/cm^2 window material, have the energy independent response within $\pm$ 20% from 0.02 to 1 MeV for beta rays which are attenuated by a 7 mg/cm^2 protective layer. Author

N69-23065# General Dynamics/Fort Worth, Tex.
COMPARISON OF THERMOLUMINESCENT AND FILM DOSIMETRY IN ROUTINE RADIATION DOSIMETRY
J. D. Eastes *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 814–829 refs (See N69-23005 11-06)
Avail: CFSTI

Routine radiation monitoring data derived from LiF thermoluminescent and DuPont 555 film dosimetry were analyzed based on the following readout procedures: (1) individual weekly readout of both; (2) accumulated totals of the weekly readout of both for a semiannual period; and (3) an annual readout of the thermoluminescent dosimeters at the end of the year versus the accumulated film results for the year. Factors which influenced these comparisons are discussed. The response of LiF dosimeters exposed repeatedly to gamma radiation ranging from 0.015 to 10.0 R delivered and read out on a weekly basis showed no variation in sensitivity throughout a 90 week period, even though some of the dosimeters had received accumulated exposures in excess of 900 R and were never annealed except as accomplished during the normal readout procedure. The natural radiation background, including possible influences from cosmic ray and internally contained sources was determined to be 60 $\pm$ 4 mR/year from the response of these dosimeters contained in badges assigned to 74 unexposed firemen. Modified readout techniques which permit the use of a storage or memory peak in the LiF glow curve for routine monitoring applications are presented along with investigative results. A brief review of several nonroutine applications of the thermoluminescent system is given, along with a short discussion of the operational experience with the system. Author

N69-23066# Kernforschungszentrum, Karlsruhe (West Germany).
ROUTINE DOSIMETRY WITH PHOSPHATE GLASSES
Ernst Piesch *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 830–852 refs (See N69-23005 11-06)
Avail: CFSTI

In addition to routine personnel application, the phosphate glasses were also used as long term accumulating dosimeters outside installations and reactors in the vicinity of a nuclear research center. The spherical dosimeter consists of a perforated tin, plastic, boron casing and a modified glass with a 40 mR lower gamma exposure limit for one year of dose accumulation. The instrument also serves as a criticality dosimeter in that the neutron induced beta radioactivity of the glass may be measured within the first 15 hours after a nuclear accident. The lower detection limit for the dose indication of fission neutrons is 0.5 rad. From a study of established procedures in routine dosimetry, examples are given of health physics applications. It was also found that multiscanning fluorescent techniques may possibly allow measurement of depth dose distribution in glass and the radiation quality for quantum radiation below 100 keV. Author

N69-23069# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
LUMINESCENCE DOSIMETRY WITH TIME LAPSE INDICATION
M. Sidran *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 883–893 refs (See N69-23005 11-06)
Avail: CFSTI

The general principles of a new type of dosimeter which indicates the time elapsed since exposure, in addition to dosage, are described. An infrared stimulated phosphor was used as the dosimeter, and the procedures for its operation are outlined. In addition, the use of thermoluminescent and electroluminescent techniques for time lapse indicating dosimetry is also discussed. Through proper fabrication of the dosimeter, it is possible to adjust the period of time during which readout can be accomplished. Such a technique may be applied to space experiments and to personnel protection systems. Author

N69-23073# Lund Univ. (Sweden). Dept. of Radiation Physics.
HIGH PRECISION DOSIMETRY USING THERMOLUMINESCENT LiF
Carl A. Carlsson, Bengt K. A. Martensson, and Gudrun Alm Carlsson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 936–943 refs (See N69-23005 11-06)
Avail: CFSTI

Effects of pre-annealing were studied, and precision in repeated dose measurements was determined by variance analysis in an investigation of the problems involved in obtaining precise measurements in dosimetry with thermoluminescent LiF. For a pre-annealing time of 22 h, following short time 300°C annealing, the standard deviation shows a minimum at a pre-annealing temperature of about −30°C. This standard deviation increases with increasing pre-annealing temperature, and is four times higher at 300°C than at −30°C. It was concluded that the influence of thermal history on the thermoluminescence of LiF is a strong argument in favor of standardization of all processes that affect it: particularly temperature, time, and cooling rates down to 100°C. High temperature pre-annealing is required for emptying traps, restoring thermal equilibrium, and receiving a high sensitivity, but this should be as short as possible; in many cases, the heating cycle used during readout may be used as a satisfactory or even superior pre-annealing process. Author

N69-23075# Jefferson Medical Coll., Philadelphia, Pa. Stein Research Center.
A PERFORMANCE STUDY OF SOLID AND PRE-PACKAGED LiF DOSIMETERS
N. Suntharalingam *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 951–962 refs (See N69-23005 11-06)
Avail: CFSTI

The use of solid and pre-packaged LiF dosimeters for routine radiation dose measurements was investigated. The reliability of measurements using LiF Teflon discs, extruded rods, high sensitivity ribbons, and sealed nylon capsules containing loose powder, and the possible reuse of these dosimeters were studied. The precision of the different systems in repeatedly measuring exposures of 50 to 400R Cobalt-60 gamma radiation was comparable, being in the order of ± 5%. Measurements with loose powder showed a precision better than ± 3%. The results of the performance of each type of dosimeter is presented in detail. Their limitations and the precautions to be taken for reuse are also discussed. Author

N69-23076# Jefferson Medical Coll., Philadelphia, Pa. Stein Research Center.
SENSITIVITY CHANGES IN SOLID THERMOLUMINESCENT DOSIMETERS AFTER SUBCUTANEOUS IMPLANTATION
B. M. Galkin, C. M. Dettmer, and N. Suntharalingam *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 963–975 refs (See N69-23005 11-06)
Avail: CFSTI

Several types of unencapsulated solid thermoluminescent dosimeters were implanted subcutaneously in rats and recovered after varying time intervals in order to check any effect of implantation on the thermoluminescence response. Matrix embedded LiF dosimeters exhibited a loss in sensitivity following implantation. Extruded LiF dosimeters seemed to react with tissue fluid. They not only exhibited a loss in sensitivity but also dissolved in the animal when left in situ for about 3 weeks. The sensitivity of $Li_2B_4O_7$:Mn Teflon rods was not affected by the implantation. Author

N69-23083# Joint Publications Research Service, Washington, D. C.
QUICK-RESPONSE HEAT GAGE ORGRES
I. Ya. Zalkind et al [1968] 8 p Transl. into ENGLISH from Teploenerg. (Moscow), v. 7, no. 7, 1960 p 87–89
(PB-180808T; JPRS-R-9471-D) Avail: CFSTI CSCL 14B

A pickup device is described which is based on the principle of equalizing the temperature of a heat flow created in an element with the temperature of a tested surface. At the moment of the equalization, the heat flow through the thermal resistance of the pickup device proves to be equal to zero. At the same time, the special design of the pickup permits the heat flow from the tested wall to be maintained without vibrations. The pickup is placed in a metal housing which has a high heat conductivity. A heating element and two resistance thermometers are installed in the housing in a heat insulated lining and are covered with a heat conducting plate; this serves for the equalization of the surface temperature and comprises the actual heating element of the device. Author (USGRDR)

N69-23086*# Aztec School of Languages, Inc., Acton, Mass.
BALANCES AND DYNAMOMETERS USED AT THE ONERA MODANE TEST CENTER [BALANCES ET DYNAMOMETRES UTILISES AU CENTRE D'ESSAIS DE MODANE-AVRIEUX]
Pierre Broussaud Washington NASA Mar. 1969 35 p refs Transl. into ENGLISH of French Rept. ONERA-NT-122
(Contract NASw-1692)
(NASA-TT-F-12173) Avail: CFSTI CSCL 14B

The problems found in the realization, design, and calibration of aerodynamic balances equipping the transonic and supersonic S-2 and S-3 wind tunnels are described. A technique of removable-dynamometer balances used for stage separation tests in the vacuum tank and for propulsion tests is described. Author

N69-23089# TRW Systems Group, Redondo Beach, Calif. Nuclear Technology Dept.
EXPLORATORY DEVELOPMENT OF THE ρ V PROPELLANT GAUGE Final Report
R. A. Kaminskas Mar. 1968 66 p ref
(Contract AT(04-3)-539)
(STL-539-0001; DR-405) Avail: CFSTI

The results of a feasibility study of two versions of an improved mass balance propellant gaging system for use under zero-gravity conditions are described. The technique is an improvement on the traditional PVT gaging system since pressure and temperature measurements are replaced with a direct pressurizing-gas density measurement using a beta ray absorption technique. This system results in a more accurate propellant gauge than the PVT gauge and is competitive in power and weight requirements. The first version, called the ρV gage, uses beta attenuation to measure the gas density in the pressurant tank. The second version called the RHO gauge, incorporates the ρV gage principle in both the propellant and pressurant tanks. In addition, an x-ray absorption technique is used in the propellant tank to measure and correct for the partial pressure of the propellant vapor. Author (NSA)

N69-23131# Porto Univ. (Portugal). Astronomical Observatory.
A SATELLITE TRACKING CAMERA
M. G. Pereira de Barros [1968] 5 p
Avail: CFSTI

The equipment, components, and capabilities of the satellite tracking camera located at the astronomical observatory of the University of Porto, Portugal, are described. A.I.

N69-23143# Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
THE UTILIZATION OF FUEL ELEMENTS IN PREPARATIVE RADIATION CHEMISTRY, AND USE OF AN ONIUM-SALT DOSIMETER [DIE VERWENDUNG VON BRENNELEMENTEN IN DER PRAEPARATIVEN STRAHLENCHEMIE UND DAS ONIUMSALZ-DOSIMETER]
H. Drawe and W. Faul Nov. 1968 12 p refs In GERMAN
(JUL-560-PC) Avail: CFSTI

Dose Rate measurements and preparative radiation chemical synthesis were carried out on burnt-out fuel elements from the reactor FRJ-2 (Dido). For this purpose, the applicability of a new, readily available dose rate meter was tried out, as well as the usefulness of burnt-out fuel elements as gamma sources for the synthesis of new compounds on a preparative scale. To this end a simple irradiation apparatus was developed. Author

N69-23169# Aeronautical Research Labs., Melbourne (Australia).
THE SUBSONIC CALIBRATION OF A HYPERBOLIC HEADED GUST MEASURING PROBE
N. Pollock Aug. 1968 16 p refs /*t*/s Aerodyn. Note 304
(ARL/A-304) Avail: CFSTI

A hyperbolic headed incidence, yaw and pitot-static probe designed for use as a wind gust measuring probe was calibrated in the transonic wind tunnel. The calibration covers a range of Mach number from 0.4 to 0.9, angles of incidence from $-5°$ to $+5°$, angles of yaw from $-5°$ to $+5°$, and a range of Reynolds numbers based on the probe diameter (2 7/8 in.) from 2.4×10^5 to 7.8×10^5. The mean sensitivity factors of the incidence and yaw calibrations were approximately 0.12. The errors in the static and dynamic pressures obtained from the probe were measured and the effect on the gust probe of mounting a Mirage pitot-static in close proximity to it was investigated. Author

N69-23191*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THIN WINDOW, DRIFTED SILICON, CHARGED PARTICLE DETECTOR
T. E. Fessler, inventor (to NASA) Issued 7 Jan. 1969 (Filed 20 Dec. 1966) 6 p Cl. 317-234 Original application, now divided, issued 21 Mar. 1967 (filed 6 Sep. 1963) US Patent 3,310,443 (US Patent Appl. SN-307-269)
(NASA-Case-XLE-10529; US-Patent-3,421,058; US-Patent-Appl-SN-603396) Avail: US Patent Office

A lithium drifted radiation detector which is especially useful for energy measurement of long range particles is described. A boron doped, p-type, silicon wafer has an aluminum coating applied to one side; lithium which is an n-type material is diffused on the opposite side of the wafer to form a high resistivity p-n junction. The aluminum coating is used as an electrical contact to drift the lithium. The impure regions are removed to form the semiconductor. This semiconductor consists of substantially intrinsic silicon with an exceedingly high effective resistivity. A thin layer of gold is applied to the surfaces to serve as a rectifying contact. This combination gives a much more uniform response to particle energy than prior intrinsic semiconductors utilizing an aluminum coating electrical contact material. NASA

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-21888# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF FRICTION CONDITIONS ON FRICTIONAL CHARACTERISTICS OF MOLYBDENUM DISULFIDE
V. E. Vainshtein, O. A. Suchkova, and V. L. Mamaiev Aug. 1968 18 p refs Transl. into ENGLISH from Mashinoved. (USSR), no. 4, 1965 p 108-114
(AD-681608; FTD-MT-24-222-68) Avail: CFSTI CSCL 11/8

The authors study the effect of the sliding rate and loading on the coefficient of friction in molybdenum disulfide. A 20-30 micron layer of molybdenum disulfide was applied to the ends of annular bronze specimens. The material for other member of the friction pair was 2Kh13 steel. The effect of surface finish on the friction properties of molybdenum disulfide was also studied. The effect of continuous stationary contact on the coefficient of friction in MoS2 was studied by applying a layer of molybdenum sulfide to the internal surface of bronze sleeves and mounting them on 2Kh13 steel shafts. TAB

N69-22173*# AiResearch Mfg. Co., Phoenix, Ariz.
DESIGN AND FABRICATION OF THE BRAYTON CYCLE HIGH PERFORMANCE COMPRESSOR RESEARCH PACKAGE Final Report
29 Nov. 1967 51 p
(Contract NAS3-9427)
(NASA-CR-72533; APS-5268-R) Avail: CFSTI CSCL 13G

Designed, fabricated, acceptance tested, and delivered to NASA was a Brayton-Cycle Compressor Research Package. The research package is aerodynamically identical to the compressor used in the NASA Brayton Rotating Units (BRU) to be delivered under the same contract. This compressor research package will be utilized at NASA for complete component performance evaluation. Author

N69-22212# Lund Univ. (Sweden). Machine Elements Div.
SUB-CAVITY PRESSURES AND NUMBER OF OIL STREAMERS IN CAVITATION REGIONS WITH SPECIAL REFERENCE TO THE INFINITE JOURNAL BEARING
Leif Floberg 1968 39 p refs /*t*/s Acta Polytech. Scand., Mech. Eng. Ser. 37
(PB-180626; APS-ME-37) Avail: CFSTI CSCL 11H

The report treats the cavitation phenomenon in journal bearings when consideration is taken for sub-cavity pressures. The influence of sub-cavity pressures will first be pronounced at low loads when they will cause considerable changes in the bearing quantities and influence the locations of the cavitation regions. The size of the sub-cavity pressure decides the number of oil streamers in the cavitation regions. The mechanism of sub-cavity pressures is studied theoretically and experimentally. It is shown that the tensile strength of a liquid is dependent of the size of gas bubbles in the liquid and the surface tension. For these bubbles equilibrium, continuity, and stability criterions are derived under adiabatic and isothermal conditions. Author (USGRDR)

N69-22217# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTISEIZING AND ANTIWEAR ADDITIVES BASED ON THE PRODUCTS OF THE REACTION OF ALKYL OR ARYL ETHERS OF GLYCEROL ALPHA-MONOCHLOROHYDRIN WITH PHOSPHORUS PENTASULFIDE
A. M. Kuliev and Z. A. Alizade Feb. 1968 8 p refs Transl. into ENGLISH from Azerb. Khim. ZH. (Baku), no. 4, 1966 p 7-9
(AD-682234; FTD-HT-23-1578-67) Avail: CFSTI CSCL 11/8

Antiwear and antiseizing lubricating oil additives with four active elements in one molecule were synthesized by the ZnO neutralization of the chlorine-containing acid bis-2(dialkoxy)-3-glyceryl dithioates. These dithioates were prepared by the

reaction of alkyl or aryl ethers of alpha-monochlorohydrin with phosphorous pentasulfide. Eight derivatives were prepared in which R was a methyl, ethyl, n-propyl, n-butyl, n-amyl, n-hexyl, phenyl, or p-tolyl radical. All acid dithioates were thick yellow oils, readily soluble in organic solvents. These Zn-salts were tested as additive oil for antiwear and antiseizing properties. A 4-ball machine was used in the test. Anticorrosion properties were tested. Author (TAB)

N69-22222*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.

HIGH-TEMPERATURE HYDRAULIC SYSTEM ACTUATOR SEALS FOR USE IN ADVANCED SUPERSONIC AIRCRAFT

Summary Report

J. Lee 15 Sep. 1967 155 p refs

(Contract NAS3-7264)

(NASA-CR-72354; FHR-2704-4) Avail: CFSTI CSCL 11A

Ten potential seal materials selected from the general categories of plastics, soft metals, and hard metals were investigated. Fluid compatibility and sliding wear tests were conducted on these materials to determine the five most suitable candidates. Seventeen rod seal configurations were investigated, and five designs were developed and evaluated in dynamic screening tests with silicone fluid. Three seal/materials combinations, each incorporating a different basic sealing concept, were evaluated in long term testing in a simulated actuator test system. The specified leakage requirement of less than one drop per minute was achieved with the polyimide V-seals during 1359 hours of operation at temperatures up to 500°F. Leakage of less than one drop per minute was also achieved with a Vascojet 1000/silver alloy reed seal and a cobalt molybdenum alloy lip seal during 574 and 279 hours of operation, respectively. The major shortcoming of the metallic seals was their limited ability to operate under boundary lubrication conditions without damaging the chrome-plated piston rod. Cracking of the material due possibly to fluid-temperature effects or deficiencies in the present seal design usually occurs after prolonged operation. Author

N69-22271# National Bureau of Standards, Boulder, Colo. Cryogenics Div.

COOLDOWN TIME FOR SIMPLE CRYOGENIC PIPELINES

W. G. Steward, R. V. Smith, and J. A. Brennan 1968 13 p refs Submitted for publication

(PB-180891; R-469) Avail: CFSTI CSCL 13K

An uncooled pipeline which is used to transfer a cryogenic fluid from one point to another must ordinarily go through a period of cooling down from ambient temperature to near the liquid boiling temperature. During most of the cooldown period the liquid boils and the pipe delivers only warm gas. This paper offers a quick method by which cooldown time for a simple system can be estimated from a dimensionless parameter read from a graph. To use the method it is necessary to know the fluid and pipe enthalpy, density, and velocity of sound in the warm gas. The idealized model and closed form solution are described, and comparison with experimental results is shown. Author (USGRDR)

N69-22307# Gulf General Atomic, San Diego, Calif.

FELTMETAL FILTER STUDIES

B. D. Snow, C. A. Perry, and R. D. Burnette 18 Jul. 1968 18 p

(Contract AT(04-3)-633)

(GAMD-8492) Avail: CFSTI

An investigation was undertaken to study the effectiveness of sintered metal filters (Feltmetal) for the removal of graphite dust entrained in helium. The program was initiated to provide needed information on the performance of the high temperature filter unit. Two series of tests were performed. The filtration efficiency of the Feltmetal material for 1 to 10 μ graphite dust was determined. The pressure drop across the filters was measured as a function of carbon dust loading, flow rate, total gas pressure, and temperature. The filters were found to be essentially 100% efficient for removal of 1 to 10 μ graphite dust. Pressure drop increased with flow rate and dust loading in an expected fashion. It was found that excessive accumulation of graphite dust on the filters could be easily removed by a simple backpurge technique. Author (NSA)

N69-22333# Societe Belge pour l'Industrie Nucleaire, Brussels (Belgium).

WELDING OF FUEL ELEMENT CANS OF AUSTENITIC STAINLESS STEEL

L. Aerts, Ph. Van Asbroeck, J. Schrijvers, P. De Boeck, and H. Bairot 1968 12 p refs In FRENCH Submitted for publication

(NP-17677) Avail: CFSTI

Fabrication of plutonium-enriched ceramic austenitic stainless steel clad fuel elements demands two welding operations. Claddings welded by the TIG argon-arc procedure, the outer diameter of the element being between 8.5 and 16 mm and the thickness being 0.5 mm are studied. The characteristics of a welding and the parameters occurring during the operation of welding are noted, the correlations between these factors are examined, a mode of operation, and the control methods of quality are described. Author (NSA)

N69-22334# Ceskoslovenska Akademie Ved, Rez.

EFFECT OF NEUTRON IRRADIATION ON MECHANICAL PROPERTIES OF WELDING A-2 AND SOME MAGNANESE–NICKEL–MOLYBDENUM STEELS

M. Vacek and V. Juricka Sep. 1968 42 p refs In CZECHOSLOVAKIAN

(UJV-2055-M) Avail: CFSTI

The radiation embrittlement and hardening of two welding metals from the low-alloy-steel and seven different heats of Mn–Ni–Mo steels have been studied. The welding joints produced by two types of welding processes namely semi-automatized arc weld in the CO_2 atmospheres and electroslag weld have been investigated. The effect of different killing elements (Al, Nb, Ti, V, Zr) and various content of nickel or manganese on radiation embrittlement and hardening have been studied for experimental Mn–Ni–Mo heats. One heat was evacuated before casting. The neutron doses ranged from 7.10^{18} to 10.10^{18} n/cm^2 (E > 1 MeV) and temperature ranged from 60 to 120°C. A part of the irradiated tensile specimens of welding metals and experimental heats was annealed 1 hr at 350°C on the recovery after irradiation. The recovery was various for different steels. Both welding metals showed roughly the same increase of the transition temperature ΔTT. Author (NSA)

N69-22449# Compagnie Générale d'Electricité, Paris (France). Dept. Physique des Matériaux.

THE ELECTROMAGNETIC LEVITATION OF SOLID BODIES AND LIQUIDS. PART 1: TEXT [PARTICIPATION A L'ETUDE DE LA LEVITATION ELECTROMAGNETIQUE DE CORPS SOLIDES OU LIQUIDES. PREMIERE PARTIE: TEXTE]

Robert Espinasse (Ph.D. Thesis—Conservatoire Natl. Arts et Métiers) 14 Dec. 1967 123 p refs In FRENCH

(Contracts DRME 64-295; DRME 66-305)

Avail: CFSTI

An electromagnetic levitation process for the preparation of metal ingots without using moulds is described. A theoretical study of the forces acting on the levitated body, especially during solidification, is made and the geometry of the inductor is considered. An experimental trial is described and the results so gained are discussed. The application of these methods to industrial processes is also considered. ESRO

N69-22450# Compagnie Générale d'Electricité, Paris (France). Dept. Physique des Matériaux.
THE ELECTROMAGNETIC LEVITATION OF SOLID BODIES AND LIQUIDS. PART 2: DRAWINGS [PARTICIPATION A L'ETUDE DE LA LEVITATION ELECTROMAGNETIQUE DE CORPS SOLIDES OU LIQUIDES. DEUXIEME PARTIE: FIGURES]
Robert Espinasse (Ph.D. Thesis—Conservatoire Natl. Arts et Métiers) 14 Dec. 1967 82 p In FRENCH
(Contracts DRME 64-295; DRME 66-305)
Avail: CFSTI

Graphs showing the geometry of the inductors and drawings concerning the electromagnetic levitation process described in the first part are represented. ESRO

N69-22456# Commissariat a l'Energie Atomique, Saclay (France).
METHOD OF ULTRASONIC CONTROL OF THIN TUBES PERMITTING SEPARATE RECORDING OF INTERNAL AND EXTERNAL LONGITUDINAL DEFECTS
J. F. Chretien and J. Huard 1968 15 p refs In FRENCH
Presented at the Symp. on Nondestructive Testing and Control in the Field of Nucl. Met. and Technol., Saclay, France
(CEA-CONF-1070; CONF-680606-7) Avail: CFSTI

In the case of tubes intended for the cladding of fuel elements, where a very high quality is required, it is extremely useful to know where the defects are located with respect to the outer and inner walls of the tube. The characteristics of the commercial instruments commonly used for ultrasonic testing of this type of tube are such that no distinction can be made between internal and external defects by the use of conventional methods. A method was developed based on differences in the damping of Lamb waves at the air–metal and metal–water interfaces. This technique may be used with any standard ultrasonic apparatus provided it possesses an amplifier with variable gain along the time base. It has been used successfully for the pre-series testing of zirconium-copper cladding of thickness varying between 0.7 and 1.2 mm. It has also been used for stainless steel tubes of 6.3 mm dia and 0.35 mm thick.
Author (NSA)

N69-22467# Commissariat a L'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
DETECTION OF WELD DEFECTS OPENING ONTO THE SURFACE THROUGH USE OF AMMONIA GAS [DETECTION DES DEFAUTS DE SOUDURE DEBOUCHANT EN SURFACE PAR RESSUAGE GAZEUX A L'AMMONIAC]
N. Chretien, J. F. Chretien, and P. Cortely [1967] 41 p refs In FRENCH Presented at the Symp. on Nondestructive Testing and Control in the Field of Nucl. Met. and Technol., Saclay
(CEA-CONF-1074; CONF-680606-5) Avail: CFSTI

A new method, based on ammonia sweating, has been perfected for the detection of surface defects in welds. The process consists of three operations: first the container surrounding the zone to be tested is evacuated; then this container is placed under ammonia pressure; and finally, after a return to atmospheric pressure, a reactive paint is applied to the specimen. Very clear patches then appear on the points showing where defects emerge at the surface such as flaws, cracks, pores. Author (NSA)

N69-22519# California Univ., Livermore. Lawrence Radiation Lab.
A CRITICAL REVIEW OF HEAT PIPE THEORY AND APPLICATIONS
Henry Cheung 15 Jul. 1968 70 p refs
(Contract W-7405-ENG-48)
(UCRL-50453) Avail: CFSTI

A critical review of the theories and experiments relating to heat pipes was made to provide an introductory reference which summarizes and interprets the information useful in practical applications. The areas to be studied to extend current knowledge are indicated. The open literature up to March 1968 is evaluated and interpreted. Author (TAB)

N69-22622# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC SHIELDS FOR SUPERCONDUCTING BENDING AND QUADRUPOLE MAGNETS
Robert B. Meuser 24 Jun. 1968 21 p
(Contract W-7405-ENG-48)
(UCRL-18318) Avail: CFSTI

The design of iron shielding for superconducting magnets and its effect on magnet design and performance are discussed. A saddle-shaped winding, circular in cross section, will produce a uniform or quadrupole field. A concentric circular iron shield will reduce the stray field, reduce the stored energy, and reduce the required ampere-turns. If the thickness of the shield is properly distributed, the field distribution in the aperture will be unchanged even though the shield saturates. Unsymmetrical shields may be used where the width must be minimized. The weight of the shield for a bending magnet is nearly independent of its size, while the weight of the shield for a quadrupole magnet decreases with increasing size. The shield has little influence on the mechanical stresses. Author (NSA)

N69-22756# Army Materials and Mechanics Research Center, Watertown, Mass.
WHISKER-MATRIX BONDING AND INTERACTION
Stanley M. Wolf and Albert P. Levitt Dec. 1968 28 p refs
(AD-682008; AMMRC-MS-68-11) Avail: CFSTI CSCL 11/4

One of the major barriers to the development of new and improved whisker- and fiber-reinforced composites is lack of understanding and control of the interfacial bond between fiber and matrix. This bond must be strong enough for load transfer from matrix to fiber and stable enough so that neither the fiber nor matrix are adversely affected by the bonding mechanism. This monograph reviews and discusses the factors affecting whisker-matrix wetting, bonding, and interaction, with particular emphasis on Al2O3 and SiC whiskers in metal. Author (TAB)

N69-22768*# Solar, San Diego, Calif.
A BRAZING PROCESS FOR Cb-1Cr HEAT RECEIVER TUBES Final Report
C. E. Smeltzer and W. A. Compton [1969] 81 p refs
(Contract NAS3-10803)
(NASA-CR-95481; RDR-1811) Avail: CFSTI CSCL 13H

A two phase program was conducted to develop a suitable braze process for attaching internal fins of Cb-1Zr foil to Cb-1Zr heat receiver tubes. Phase 1 was concerned with the selection, development, and evaluation of candidate braze systems, as well as with the determination of fabrication feasibility and brazing studies upon subscale heat receiver tube modules. Phase 2 involved actual fabrication and vacuum brazing of two full scale heat receiver tubes employing the optimum braze alloy, Zr-28V-16Ti-0. 1Be. Author

N69-22852# Los Alamos Scientific Lab., N. Mex.
ONE-STEP CLOSURE SEALING OF PRESSURIZED CAPILLARY TUBING
Paul M. Giles and Karl A. Esch Sep. 1968 10 p
(Contract W-7405-ENG-36)
(LA-3991) Avail: CFSTI

Since 1964 the Los Alamos Scientific Laboratory of the University of California has routinely sealed Type 304-L stainless steel capillary tubes, pressurized to as high as 24 kpsi, by pinch

welding. Welds of tubing under pressure, made upon intermittent demand over this 4-year period, have without exception exhibited leak rates of less than 10^{-10} standard cc/sec. A summary of the method, equipment, welding parameters, and some auxiliary techniques is presented. Author (NSA)

N69-22970*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE AND EVALUATION OF TWO LIQUID-METAL PUMPS FOR SODIUM-POTASSIUM SERVICE

Sol H. Gorland, Thomas P. Hecker, and Roy A. Lottig Washington Apr. 1969 16 p refs

(NASA-TM-X-1765) Avail: CFSTI CSCL 13L

Two identical hermetically-sealed motor-driven centrifugal pumps operated for 1483 hours in NaK loops, one at 1150° F (895 K) and the other at 450° F (505 K). The pumps incorporate NaK-lubricated tilting-pad journal and thrust bearings, and were designed to withstand a nuclear radiation environment. The induction motors were "canned" inside the pump housings to eliminate the need for absolute seals between the pump and the motor. Both pumps operated successfully for the 1483 hours without maintenance. There were no parametric excursions outside the envelopes considered safe for 10,000 or more hours of operation. Author

N69-22992*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE THERMAL STABILITY AND FRICTION OF THE DISULFIDES, DISELENIDES, AND DITELLURIDES OF MOLYBDENUM AND TUNGSTEN IN VACUUM

William A. Brainard Washington Apr. 1969 24 p refs

(NASA-TN-D-5141) Avail: CFSTI CSCL 11F

Thermal stability and friction experiments were conducted with the disulfides, diselenides, and ditellurides of molybdenum and tungsten in ultrahigh vacuum. Weight loss rates were plotted as a function of temperature; thermal dissociation temperatures were observed by mass spectrometry. Friction experiments showed the materials were limited as high temperature lubricants by evaporation, dissociation, and wear. Generally, as lubricants, the diselenides provided the best performance up to 1400° F, whereas the ditellurides provided the poorest because of a low thermal dissociation temperature. Author

N69-23003# Swedish State Shipbuilding Experimental Tank, Goteborg.

A METHOD FOR THE DESIGN OF DUCTED PROPELLERS IN A UNIFORM FLOW

Gilbert Dyne 1967 27 p refs Sponsored by the Hugo Hammer Found. and the Martina Lungren Found. for Maritime Res.

(PB-179546; Publ-62) Avail: CFSTI

A method for the design of ducted propellers in a uniform flow is presented. Starting from known values of total thrust, number of revolutions, propeller diameter, blade number and form, distribution of blade circulation, duct vorticity and minimum cavitation margin the method determines blade area, propeller efficiency, duct thrust, shape of duct and pitch, camber and thickness of the propeller blade sections. The definite strength of the vortex systems of the propeller and the source-sink systems of the duct and the hub is determined by an iteration process in such a way that the desired total thrust is obtained. The total thrust is calculated according to the momentum theorem and the thrust of the propeller according to the law of Bernoulli. The axial velocities induced by the singularities are calculated at different radii along the duct. The shape of the duct is then determined by the law of continuity. Author

N69-23188*# TRW Systems, Redondo Beach, Calif. Space Technology Labs.

ELECTROMECHANICAL ACTUATOR

Donald D. Laine, inventor (to NASA) Issued 14 Jan. 1969 (Filed 3 Aug. 1966) 8 p Cl. 239-416 Prepared for JPL

(Contracts NAS7-100; JPL-950596)

(NASA-Case-XNP-05975; US-Patent-3,421,700; US-Patent-Appl-SN-570097) Avail: US Patent Office

An electromechanical actuator is described. It is intended for use in a rocket thrust control valve whereby thrust control is executed by proportioning and metering the flow of fuel and oxidizer into the combustion chamber of a rocket engine. The linear actuator consists of an actuator body and a driven member having coacting motion translating means for effecting linear movement. A stator is affixed to the body and a rotor is affixed to the driven member. Commutating means, including a commutator on the rotor and commutator brushes on the stator, are adapted so as to allow the brushes to remain in contact with the commutator throughout its linear travel. Thus it can be readily seen that as the rotor is turned and an electrical current energizes the stator, the driven member will move easily because of the coacting means. The direction of rotation determines the direction of axial movement. The linear actuator is used in the rocket thrust control valve to provide axial movement to a valve sleeve. The axial movement of the valve sleeve controls the size of oxidizer passage and fuel passage. Axial movement in one direction decreases the size of the passage and axial movement in the opposite direction increases the size of the passage. NASA

N69-23190*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

REFRIGERATION APPARATUS

Walter H. Higa, inventor (to NASA) Issued 14 Jan. 1969 (Filed 26 Jan. 1968) 9 p Cl. 62-6 Continuation-in-part of US Patent Appl. SN-574282, filed 19 Aug. 1966

(Contract NAS7-100)

(NASA-Case-NPO-10309; US-Patent-3,421,331; US-Patent-Appl-SN-700985) Avail: US Patent Office

A refrigeration apparatus is disclosed which is based on the utilization of a constant intermediate pressure acting on the upper surface of a piston, coupled to the surface of a displacer. In this manner, the displacer can be reciprocally driven by a very simple two position valve assembly. A cryogenic assembly for attaining liquid helium temperatures is provided by utilizing the refrigerator to cool through a counter-current heat exchanger comprising a cylinder with a helically corrugated surface disposed between concentrically oriented bodies defining two adjacent passages, a stream of gas which is filtered and expanded in a fixed, distributed restriction Joule-Thompson valve. A gas-filled thermal switch selectively couples the refrigerator in heat conducting relation with the heat load. Official Gazette of the U.S. Patent Office

N69-23232*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION FOR ADVANCED GAS TURBINE ENGINES

Robert L. Johnson and Lawrence P. Ludwig Washington Apr. 1969 23 p refs

(NASA-TN-D-5170) Avail: CFSTI CSCL 11A

The need in advanced engines for shaft seals with improved pressure, temperature, and speed capabilities is pointed out. In particular, the high speed requirement suggests that the seals must not have rubbing contact. Labyrinth seals have disadvantages in high leakage (efficiency loss) and debris entrainment, and conventional face seals are subject to high wear because face deformation can increase seal closing force and thus cause heavy rubbing contact. It is shown that incorporation of self-acting lift pads to the conventional face seal prevents rubbing contact even though face

deformation occurs; feasibility was demonstrated in 560 hours of operation at 100-pound-per-square-inch pressure differential, 600° F gas temperature, and 380-feet-per-second sliding speed. Positive separation of the sealing faces with acceptable leakage rates was obtained. Proposed advanced systems using seals with self-acting lift pads are described. Author

N69-23310# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Soil Mechanics.
TERRAIN CLASSIFICATION FOR ENGINEERING PURPOSES OF THE ROLLING DOWNS PROVINCE, QUEENSLAND
K. Grant 1968 384 p refs *Its* Div. of Soils Mech. Tech. Paper no. 3
(PB-180801) Avail: CFSTI CSCL 13B

The terrain of parts of the Rolling Downs Province, Queensland, and included and bounding provinces has been classified for engineering purposes in terms of provinces, terrain patterns, terrain units, and terrain components in accordance with the P.U.C.E. program. Full descriptions of classes at each level of generalization are presented. It is considered that few more terrain patterns, terrain units, or terrain components will require recognition and description to complete the classification of the whole province. Author (USGRDR)

N69-23336# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOME EXPERIMENTAL RESULTS FOR EFFICIENT HELIUM LOW TEMPERATURE HEAT EXCHANGERS
A. M. Arkharov et al [1968] 4 p ref Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 11, 1968 p 99–103
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Experimental scavenging results and an analysis of the optimal structural relationships for Hampson type heat exchangers are presented for transient helium flow modes. Problems involved in making an analytical determination of the hydraulic drag of bundles of tubes, around which a transverse stream flows, are discussed; and for this reason drag calculations are usually based on experimentally obtained values. Forward and reverse flow drag measurements were made. The results of scavenging showed the discrepancy between the obtained values and those calculated by a previous formula. Total hydraulic drag, drag coefficient, and the influence of wall roughness are also treated. A.C.R.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-21965 Stanford Univ., Calif.
STUDIES OF OPTICAL FREQUENCY PARAMETRIC OSCILLATION
Malin Kenneth Oshman (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-11232

Theoretical and experimental aspects of optical frequency parametric oscillation were investigated. An analysis of a parametric oscillator with the nonlinear crystal inside the laser cavity was performed and the equations of motion of such an oscillator are derived. A stability analysis of the various regions showed that they were mutually exclusive and could be experimentally chosen by changing the laser gain, the oscillator output coupling, or the magnitude of the nonlinear interaction. This stability analysis confirmed the assumption that the high pump fields inside the laser were useful in overcoming threshold for oscillation. The internal oscillator efficiency rapidly approached the Manley–Rowe limit as the available pump power became several times greater than that required for threshold. The efficiency of an oscillator consisting of a triply-resonant optical cavity and the nonlinear crystal was calculated. Dissert. Abstr.

N69-21979 Cornell Univ., New York.
PHYSICS, ELECTRONICS AND ELECTRICITY: DOUBLE RESONANCE SPECTROSCOPY IN GAS LASERS
Terry Owen Carroll (Ph.D. Thesis) 1968 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-11616

A theory of double resonance in gas lasers is formulated that relates the laser intensity to the response of atoms in the active medium. Analytic expressions are derived for the intensity of a single-mode laser oscillating on a J = 1 to J = 0 atomic transition. A dc magnetic field transverse to the direction of propagation of the optical field and an rf magnetic field orthogonal to the dc magnetic field are applied to the active medium. Changes, or resonances, in the laser intensity are predicted when the Larmor frequency equals the rf frequency due to rf transitions between the Zeeman sublevels, and at other values of the dc magnetic field due to coherence (state-mixing in the atomic wave function) effects. These effects are the stimulated emission equivalents of Brossel–Bitter resonance and Dodd and Series resonance, respectively. Experimental results are in good agreement with the theory. Dissert. Abstr.

N69-22061 Texas Univ., Austin.
A UNIQUE LASER DETECTOR UTILIZING THE PHOTODIELECTRIC EFFECT IN COOLED SEMICONDUCTORS
Jackie Lee Stone (Ph.D. Thesis) 1968 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-10889

A transmission line equivalent circuit was used to accurately predict the behavior of a photodielectric detector. The photodielectric receiver was used in the design of an optical communication system used to detect video rate, amplitude modulation of 9000 Å infrared light source. Communication systems are described but practical considerations of the state-of-the-art utilize the phase change of a frequency modulated re-entrant cavity. A cryogenic environment was used to suppress thermally generated free carriers and to allow operation of the cavity in the superconducting mode. A 60 ohm-cm, p-type germanium sample was used to detect a video modulated 9000 Å light source using purer samples and carefully controlling the detector design parameters indicated the possibility of bandwidths greater than 100 MHz. Applications include wide bandwidth, multi-channel information bands, secure communication links, deep space probe communications system, and a device for basic material's properties studies. Dissert. Abstr.

N69-22344# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A He-Ne LASER INTERFEROMETER FOR THE APPLICATION TO PLASMA DIAGNOSTICS [DIE VERWENDUNG EINES GASLASER-INTERFEROMETERS ZUR PLASMADIAGNOSTIK]
J. Freund Jun. 1968 43 p refs In GERMAN; ENGLISH summary
(IPP-1/88) Avail: CFSTI

The physical and experimental principles of a modified Ashby-Jephcott IR laser interferometer for electron area density measurements of either long or toroidal plasma discharges are

described. In this interferometer the IR beam is reflected back onto itself by an external mirror oscillating at low frequency, and is detected by a fast, sensitive semiconductor detector. The mirror oscillator has been constructed so that it is stable against misalignment, and is used only during the linear part of its sinusoidal oscillation. Modulation frequencies up to 2 Mc/s are obtainable. In the case of plasma between the driven mirror and the laser resonator there is an additional modulation superimposed upon the periodical modulation caused by the mirror which corresponds to the electron area density changes of the plasma. It is possible to evaluate area densities as low as 10^{15} electrons/cm^2 with a time resolution of 0.5 μsec. The area density measured across the diameter in the middle plane of a z-pinch discharge has been compared with the results of Mach-Zehnder interferograms taken along the z-axis. Author (ESRO)

N69-22385# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE FEASIBILITY OF INCREASING OUTPUT POWER FROM A CO2-N2-HE MIXTURE

P. A. Bokhan and E. S. Egorova Apr. 1968 7 p refs Transl. into ENGLISH from ZH. Prikl. Spektroskopii, Akad. Nauk Belorussk. SSR (Minsk), v. 7, no. 6, 1967 p 954-956
(AD-681579; FTD-HT-23-252-68) Avail: CFSTI CSCL 20/5

The achievement of higher output power in CO2 lasers with large-diameter discharge tubes is hampered by a tendency toward a pinch effect and ineffective cooling of the gas. An attempt to overcome these problems was made with noncontracting discharge using a water-cooled discharge tube 70 mm in diameter and a discharge gap 150 cm long. Maximum input power was 2200 W. The output was 95 W at an efficiency of 4.3% and a wavelength of 943/cm. The thermal source density was constant over the tube cross section, and the wall temperature was 0C. At 2200 W input with He, the axial temperature rose to 280C. In view of the nonlinear input-temperature curve, an axial temperature of 500C in the presence of He requires a nearly doubled tube diameter which quadruples the output power obtained from a 1 m length of the tube. Considering that cooling and emission extraction can be further improved, and also that water vapor can be introduced into the discharge, a power output per m of 300-400 W is possible. TAB

N69-22404# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).

A CARBON DIOXIDE GAS LASER FOR CONTINUOUS HEATING OF THE PLASMA SOURCE IN THE 'WENDELSTEIN' STELLARATORS [EIN KOHLENDIOXYD-GAS-LASER ZUR KONTINUIERLICHEN HEIZUNG DER PLASMAQUELLE IN DEN 'WENDELSTEIN'-STELLARATOREN]

M. Lipa Nov. 1968 13 p refs in GERMAN; ENGLISH summary
(IPP-2/73) Avail: CFSTI (IPP-2/73) Avail: CFSTI

A CO_2-gas laser which radiates about 150 watts in the wave-length region around 10.6 μm, has been built. This light power is high enough to heat the plasma source, a tantalum sphere of 3 mm diameter, up to an equilibrium temperature of 2600°K. Author (ESRO)

N69-22473# Siemens and Halske A. G., Munich (West Germany).

MEASURING AND TRANSMISSION TECHNIQUE USING LASER BEAMS. BASIC PROBLEMS OF LASER OSCILLATORS [MESS- UND UEBERTRAGUNGSTECHNIK MIT LASERSTRAHLEN. GRUNDPROBLEME VON LASERSENDERN]

D. Roess and D. Rosenberger Oct. 1968 44 p refs In GERMAN; ENGLISH Sponsored by Bundesmin. für Wiss. Forsch.
(BMWF-FBW-68-66) Avail: CFSTI

Laser beams can be used as information carriers for radar and telecommunication systems in space applications. With the support of the German Ministry of Scientific Research basic problems of laser oscillators and of laser systems were studied. New results were gained concerning the excitation and oscillation mechanism of gas lasers, the resonator problems and stability criteria of solid state lasers, and the properties of optical detectors and communication systems. Author (ESRO)

N69-22811# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.

AN INVESTIGATION INTO THE CAUSE OF SELF-INDUCED DIVERGENCE OF LASER LIGHT IN LIQUIDS Final Report

Seymour S. Alpert 1 Aug. 1968 27 p refs
(PB-180742; SC-CR-68-3687) Avail: CFSTI

The optical effects of light absorption in liquids were studied. Thin (2mm to 1cm) quartz cells were filled with a variety of liquids and dyes. About 70 mwatts or less of laser light was focused down into the thin cells. Complicated ring structures resulted with features the details of which had not previously been reported upon in the literature. It was decided to study this effect which is believed to be thermally induced interference in greater detail; the original goals of such a study were to determine the cause of the complex ring structure and to deduce if possible the relevant thermal parameters involved. Author (USGRDR)

N69-22814*# Pennsylvania State Univ., University Park. Radio Astronomy Observatory.

A 36GHz TRAVELING WAVE MASER FOR USE IN RADIO ASTRONOMY

Paul N. Swanson 27 Jan. 1969 94 p refs
(Grant NGL-39-009-015(8))
(NASA-CR-100616; SR-017) Avail: CFSTI CSCL 20E

A theoretical analysis is made of a maser radiometer system, using data from previous maser amplifier and electron paramagnetic resonance experiments. The development of a low noise traveling wave maser radiometer is studied in terms of its intended use as a radio frequency preamplifier, paramagnetic materials available, energy levels, magnetic field, and practical construction problems. The construction of a prototype maser, to confirm or deny the theory, is then described. Optimization is discussed with relation to gain, bandwidth, frequency, and noise figure of the maser. Using the information obtained from the prototype, a final maser amplifier was constructed; it is assessed in terms of its comparison to theory and its operation. A major deviation from the original design was caused by a reevaluation of the dielectric constant of rutile. Associated equipment, including microwave hardware, the cryogenic system to cool the maser, a high vacuum system for insulation of the cryogenic system, and the superconducting magnet, is also described. P.A.B.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-21959 Illinois Univ., Urbana.
MEAN ADSORPTION LIFETIMES AND BINDING ENERGIES OF SILVER AND GOLD ON CLEAN, OXYGENATED AND CARBURIZED TUNGSTEN SURFACES
Alfred Cho (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-12092

Direct measurements of the mean adsorption lifetimes and the binding energies of silver and gold have been made on a polycrystalline tungsten substrate. The lifetime was determined by the time constant of the exponential increase of the surface concentration when an atomic beam impinged on the substrate. The binding energy was determined by the slope of the logarithm of the lifetime as a function of the inverse substrate temperature. The experiments were conducted in an ultrahigh vacuum system free of hydrocarbon contamination. A clean substrate surface was obtained by heating in a partial pressure of oxygen for a long period of time and flashing to 2500°K before each data point was taken. The well-defined surface condition and the precisely known temperature allow reliable interpretation of the experimental results.
Dissert. Abstr.

N69-22002 Wisconsin Univ., Madison.
SOME ELECTROCHEMICAL CONSIDERATIONS IN STRESS CORROSION CRACKING
John Parsons Frenck (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-9076

The object was to use potentiostatic testing to obtain data from chloride electrolytes, and from the data to establish the extent to which electrochemistry is involved in stress corrosion cracking. Commercial and laboratory alloys in various metallurgical conditions were tested in normal H_2SO_4, HCl, and $MgCl_2$ saturated at 25°, 50°, and 75°C. Passivation was obtained in H_2SO_4, but not in chloride electrolytes, which gave high current densities for all values of anodic polarization. Also, there was little change in electrochemistry with chemical composition. An anodic current density limit of 100 ma/cm^2 at 154°C was set by concentration polarization. Conclusions are that there is insufficient anodic current density available from electrochemical considerations to account for observed average crack propagation rates, that the current density that is available is relatively independent of the alloy composition. Therefore the mechanism must include an additional stress term which either is, or produces, composition dependence.
Dissert. Abstr.

N69-22017 Case Western Reserve Univ., Cleveland, Ohio.
STRUCTURAL EFFECTS ON STRESS RUPTURE AND SUPERPLASTICITY BEHAVIOR IN Co-W ALLOYS
Constantine Vishnevsky (Ph.D. Thesis) 1967 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-10191

Stress rupture tests of four Co-W base alloys were conducted at 1800° and 1850°F in air. As-cast specimens produced in conventional investment molds and by unidirectional solidification were tested. These alloys were also extruded to investigate the properties of hot worked structures. Variable strain rate tests of extruded Co-45W-0.05Zr (wt. %) at 1800°F were employed in a study of superplasticity. The influence of unidirectional solidification on the rupture life and ductility was determined by the alignment of grain boundaries competing with the geometry, orientation, and distribution of second phases. The existence of superplasticity in extruded Co-45W-0.05Zr was established. The necessity of a fine structure for superplasticity was demonstrated; the role of phase transformation was secondary. Continued recrystallization or grain boundary migration during deformation was suggested by microstructural evidence.
Dissert. Abstr.

N69-22047 Rensselaer Polytechnic Inst., Troy, N.Y.
STRUCTURE AND STRESS-STATE SENSITIVITY OF FRACTURE MECHANISMS IN TWO-PHASE MATERIALS
Thomas Earl Davidson (Ph.D. Thesis) 1968 239 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-13507

The effects of a superposed hydrostatic pressure of up to 24 kbars upon the ductility of a series of annealed and spheroidized Fe–C alloys ranging in carbon content from 0.004 to 1.1% are investigated. The effects of pressure upon ductility is found to be highly structure sensitive in terms of the presence, amount, and distribution of the cementite. In the absence of cementite or when the cementite is in spherical form in a ferrite matrix, the relationship between pressure and true strain to fracture is observed to be linear with the slope increasing with increasing carbon content. When the cementite is in platelet from (pearlite) or in a continuous network along prior austenitic grain boundaries, the relationship between pressure and true strain to fracture is nonlinear and varies considerably with carbon content and structure.
Dissert. Abstr.

N69-22048 Rensselaer Polytechnic Inst., Troy, N.Y.
AN EXPERIMENTAL INVESTIGATION OF THE CONSTITUTIONAL LIQUATION HYPOTHESIS
Richard H. Dudley (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-13533

The effects of rapid heating upon the microstructure of an alloy which has caused hot cracking difficulties during welding, AISI Type 347 stainless steel, were studied. The programming, control, and heating mechanism of a hot ductility testing machine were used to subject specimens to heating under control at linear rates up to and including 2500 F°/sec. A technique was developed for cooling specimens to room temperature at rates in excess of 60,000 F°/sec for preservation of the high temperature microstructure. Experiments were conducted to determine the effects of heating rate on the microstructure, and the effect of time and temperature on the rate of dissolution of particles identified as columbium carbide. Microstructural features not resolvable under the light microscope were studied by electron microscope techniques.
Dissert. Abstr.

N69-22049 North Carolina State Univ., Raleigh.
A STUDY OF THE ADHESION OF NICKEL
James McLure Bradford, Jr. (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-14645

An investigation was conducted, at a pressure of about 10^{-9} torr, to determine the parameters which control the adhesion (cold welding) of nickel to nickel. The surfaces were prepared for the adhesion tests by argon ion bombardment and heating. The change in the work function of the test samples during the cleaning procedure was used to indicate the degree of cleanliness of the surfaces and was correlated to the change in the adhesion coefficient during the cleaning procedure. The adhesion coefficient was at its maximum value when the surface was in its cleanest state. The adhesion coefficient was measured by putting the samples together with a contact force normal to the surfaces, and then measuring the force required to break the adhesion joint formed.
Dissert. Abstr.

N69-22054 California Univ., Berkeley.
ACTIVATING HOT PRESSING OF MAGNESIUM OXIDE
Patrick Eugene Hart (Ph.D. Thesis) 1968 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-13911

The densification by pressure sintering of magnesium oxide compacts, containing minor lithium fluoride additions, was studied. Densification is considered to be a three step process with the first two steps occurring in the fabrication die and the last step, annealing, being performed after pressing. Samples having hot pressed densities in excess of 99.1%, relative to pure magnesium oxide, become transparent during annealing. Dissert. Abstr.

N69-22082 Illinois Univ., Chicago.
MARTENSITIC TRANSFORMATION OF A COBALT–NICKEL ALLOY UNDER TENSILE STRESS
Emmanuel de Lamotte (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12103

The influence of an external stress on the allotropic transformation of single crystals of a cobalt-30.5% nickel alloy was investigated. Experimental results were obtained from dilatometry, X-ray diffraction, optical and electron microscopy. The stresses could be conveniently divided into three ranges. In range I, from 0 to about 400 g/mm^2, the specimens exhibited on cooling a multivariant phase change and a considerable amount of retained cubic material. In range II, from 400g/mm^2 to the elastic limit (2000 g/mm^2), the product phase had a simpler morphology. Single hexagonal regions grew in size and the cubic phase disappeared with increasing stress level. In range III, just above the elastic limit, specimens transformed into hexagonal single crystals. Specimens prestressed in range III and transformed in range I also became hexagonal single crystals. Dissert. Abstr.

N69-22088 Pennsylvania State Univ., University Park.
SURFACE STRUCTURE AND SUBLIMATION OF SEMIMETALS
Michael Brendan Dowell (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-11978

The present thesis discusses the surface changes which occur during the vaporization of (111) cleavage faces of arsenic and antimony single crystals. Vaporization of arsenic and antimony (111) cleavage faces is accompanied by the development and growth of trigonal pits at sites of spiral dislocations. These pits grow until the entire surface appears as a jagged mass of intersecting planes. The angle between the side of the pit and the (111) surface of arsenic is about 11°, ranging from 9° to 13°, while the angle between the side of a pit and the antimony (111) surface is about 5°, ranging from 2° to 9°. Within experimental error, all mass loss during vaporization is attributable to the growth of these pits. All of these data are consistent with a model of the vaporization process in which the As_4 or Sb_4 gaseous species, which does not exist as such in the crystal lattice, is detached from a kink on a ledge associated with a spiral dislocation. Dissert. Abstr.

N69-22115# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgy and Materials Science.
STRESS CORROSION OF THE ALUMINUM ALLOY 7075-T651 IN ORGANIC LIQUIDS Final Report
R. P. M. Procter and H. W. Paxton Sep. 1968 50 p refs Presented at the Fall Meeting of ASTM, Atlanta, Ga., 29 Sep.–4 Oct. 1968
(Contract Nonr-760(31))
(AD-682228) Avail: CFSTI CSCL 11/6

It was shown that stress-corrosion cracks will propagate from a fatigue-precrack in 7075-T651 aluminum alloy exposed to various organic environments; stress-corrosion cracks will not, however, initiate in smooth specimens. Evidence is presented which indicates that the crack propagation is probably not due to traces of water absorbed in the oxide film at the crack tip or in the environments. The stress-corrosion crack growth rate was measured in ethanol and carbon tetrachloride as a function of the plane-strain stress-intensity factor K. The results of a fractographic analysis of the fracture surfaces are described. Evidence is presented to show that some limited dissolution of aluminum in the environments occurs and it is suggested that, as with aqueous stress-corrosion of aluminum alloys, an electrochemical reaction is involved in the cracking. Author (TAB)

N69-22139# Oulu Univ. (Finland).
THE AVERAGE ABSORPTION OF MONOCHROMATIC X-RAYS AS A FUNCTION OF PARTICLE SIZE IN MULTIPHASE SYSTEMS
E. Suoninen 1968 29 p refs *Its* ACTA Polytech. Scand., Phys. Nucl. Ser. 54
(PB-180621; APS-PH-54) Avail: CFSTI CSCL 11F

The local variation of absorption in a multicomponent sample due to a local variation of the sample structure is the basis of the well-known radiographic methods using x-rays or gamma-rays or beams of charged particles. The aim of the present work is to investigate the influence of the distribution of a strongly absorbing phase, embedded in a less absorbing matrix, upon the average transmission of radiation through a sheet of constant thickness. USGRDR

N69-22187*# Bean (William T.), Detroit, Mich.
RESEARCH PROGRAM TO DEVELOP ALLOYS FOR UP TO 1200° F STRAIN GAGES
William T. Bean Mar. 1969 116 p
(Contract NAS1-4694)
(NASA-CR-66775) Avail: CFSTI CSCL 11F

Fifteen alloys were studied in unfinished form and in actual strain gage configurations for their suitability in measurements of steady state strains up to 1200° F. The alloys were vacuum melted, and wire samples with diameters of 0.005", 0.002", and 0.001" were drawn. One alloy was reduced to foils having thicknesses of 0.0004" and 0.0002". Among the tested alloys were three nickel-base superalloys, an iron-base superalloy, a cobalt-base superalloy, and several alloys of platinum–copper, platinum–nickel, and platinum–tungsten. An improved ceramic cement was used as bonding agent in mounting the test specimens. Strain gage filaments were connected to lead-in wires by means of Nichrome ribbons. The test results are presented in graphs and tables. K.W.

N69-22215# British Steel Corp., London (England). Metallurgy Div.
THE CONTROLLED PROCESSING OF LOW CARBON STRUCTURAL STEELS: BISRA OPEN REPORT
J. J. Irani and G. Tither 11 Dec. 1967 14 p refs
(PB-180447; MG/A/80/67) Avail: CFSTI CSCL 11F

This has led to the development of semikilled, low carbon steels containing secondary hardening elements. The significance and effect of niobium was considered in this paper, particularly with reference to controlled rolling, quenching, and tempering. Author (USGRDR)

N69-22286# British Steel Corp., London (England). Metallurgy Div.
SOME ASPECTS CONCERNING THE EXTRAPOLATION OF RUPTURE DATA: BISRA OPEN REPORT
J. Glen and R. F. Johnson 11 Dec. 1967 12 p refs Presented at the Conf. on Steels for the Power and Chem., Czech., 24-27 Oct. 1967
(PB-180451; MG/Q/152/67) Avail: CFSTI CSCL 11F

One hundred thousand hour values predicted by means of present extrapolation techniques can differ appreciably from the

true values based on actual data. The error involved increases with the duration over which the extrapolation is carried out. Recent evidence from a number of countries shows that the predicted values are usually optimistic and reasons why this may be so are suggested. Author (USGRDR)

N69-22288# British Steel Corp., London (England). Metallurgy Div.

LOW TEMPERATURE ROLLING OF UPPER BAINITIC STRUCTURES: BISRA OPEN REPORT

D. Dulieu and J. J. Irani. 1968 23 p refs

(PB-180449; MG/A/30/68) Avail: CFSTI CSCL 11F

Rolling schedules and thermal treatments involving recrystallisation of the austenite, and also those involving deformation without recrystallisation, deformation during transformation and warm working of upper bainite, were examined. Changes in mechanical properties were correlated with changes in the microstructure. Author

N69-22289# British Steel Corp., London (England). Metallurgy Div.

THE EFFECT OF THERMAL AND THERMOMECHANICAL TREATMENTS ON THE TEMPER EMBRITTLEMENT OF LOW ALLOY SHEETS: BISRA OPEN REPORT

J. J. Irani, M. J. May, and D. Elliott. 1968 30 p refs

(PB-180448; MG/A/81/67) Avail: CFSTI CSCL 11F

The effects of rapid heating and ausforming on the phenomenon of temper embrittlement were examined in two low alloy martensitic steels and the results contrasted with those for conventionally treated material. Author

N69-22303# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

ULTRAHIGH-VACUUM ZONE PURIFICATION OF ZIRCONIUM WITH ANALYSIS OF PARTIAL PRESSURES

D. S. Easton and J. O. Betterton, Jr. Dec. 1968 51 p refs

(Contract W-7405-eng-26)

(ORNL-4309) Avail: CFSTI

An electron-beam zone refiner was developed to produce high-purity zirconium and other refractory metals for use in high-field galvanomagnetic studies. A quadrupole gas analyzer was used to monitor the gas composition over various metals during zoning. Resistance ratios ($R_{300°K}/R_{4.2°K}$) and chemical analysis provided indications of purity levels. Zirconium was successfully zone refined up to 65 zone passes for oxygen removal. The low partial pressures in the system made these lengthy operations possible without contamination. Resistivity ratios of up to 1300 in zirconium and 300 in hafnium were achieved. Author (NSA)

N69-22337# Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Material- und Festkoerperforschung.

MECHANICAL PROPERTIES OF URANIUM DIOXIDE

G. Engelhardt. Feb. 1968 54 p refs Transl. into ENGLISH of German Rept. KFK-729 Prepared under US-EURATOM Fast Reactor Exchange Program

EURFNR-528; EUR-3729.d; KFK-729) Avail: CFSTI

Several studies have been made of the main UO_2 elastic and plastic properties. However, the dependence of characteristics on externally and structurally determined parameters has only been partially determined. UO_2 does not have unusual mechanical properties for an oxide ceramic material. The controlling lattice physics phenomena are noticeably influenced by grain size, porosity, and extraneous ions. In the elastic property studies, the influence was registered phenomenologically; there is no basis for an atomistic understanding of the dependences found. Author (NSA)

N69-22343# Compagnie Générale d'Electricité, Paris (France). Dept. Physique des Matériaux.

A STUDY OF THE ANODIC OXIDES OF TITANIUM, NIOBIUM AND TANTALUM: GROWTH MECHANISM, INTERFACIAL PHENOMENA, CONTRIBUTION TO THE KNOWLEDGE OF THEIR STRUCTURE [ETUDE D'OXYDES ANODIQUES DE TITANE, DE NIOBIUM ET DE TANTALE: MECANISME DE CROISSANCE, PHENOMENES INTERFACIAUX, CONTRIBUTION A LA CONNAISSANCE DE LEUR STRUCTURE]

Francois Kover (Ph.D. Thesis—Paris Univ.) 2 Jun. 1967 100 p refs In FRENCH

(Contract 62.FR.115)

The growth process of electrochemically deposited titanium, niobium and tantalum oxides prepared in different electrolytes are compared and a relation is given between the quantity of current, and the thickness and capacity of the deposits. The results from experiments are discussed, particularly interfacial phenomena, and a method which involves the use of oxygen 18, for determining the oxygen content in the deposits is described. The apparent efficiency of the process is also discussed. ESRO

N69-22348# British Steel Corp., London (England). Metallurgy Div.

CONFIDENCE IN PROOF STRESS PROPERTIES

B. H. Rose and H. G. Thureton. Oct. 1967 8 p refs Presented at the Conf. on Steels for the Power and Chem. Industry, Czechoslovakia, 24–27 Oct. 1967

(PB-180450; MG/Q/151/67) Avail: CFSTI CSCL 11F

The paper details various methods known to be used throughout the world to derive minimum proof stress values at elevated temperatures for standards and other purposes. The methods are discussed in some detail and it is clear that, depending on the method used, different values can be derived for the same steel. An agreed international method for assessing proof stress data is imperative and it is suggested that a method similar to that proposed by the British Steelmakers' Creep Committee, which enables minimum values to be related to a particular statistical confidence level, is the one which should be used. Author (USGRDR)

N69-22386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF CARBON ON THE STRUCTURE AND STRENGTH CHARACTERISTICS OF NIOBIUM AND ITS ALLOYS

I. S. Malashenko. Mar. 1968 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metally (Moscow), no. 3, 1967 p 159–166

(AD-681593; FTD-HT-23-192-68) Avail: CFSTI CSCL 11/6

The microstructure and mechanical properties of niobium alloys containing 0.1, 0.15, or 0.20% carbon, or 16.5% tungsten and 0.1 or 0.15% carbon, or 16.5% tungsten, 0.5% zirconium and 0.1% carbon have been investigated. Alloys were electron-beam melted from sodium-reduced niobium and 99.88%-pure tungsten and zirconium and tested in the as-cast or heat-treated condition. The structure of Nb-C alloy consisted of a homogeneous solid solution containing particles of carbide phase which was identified as Nb2C carbide with a hexagonal structure. No complex carbides were found in ternary Nb-W-C system. The strength of as-cast Nb-C alloys increased with increasing carbon content and reached a maximum of about 23 kg/sq mm at 0.10% C, but the ductility dropped. With further increases in carbon content, both the strength and ductility decreased. Alloy with 0.10-0.15% C was forged with 80% reduction at 1000C without cracks; alloy with 0.20% C, at the same or higher temperature, was unworkable. In Nb-W-C alloys a maximum strength of 50 kg/sq mm was reached at 0.10% C, at which the elongation dropped to 2-5%. The addition of 0.5% zirconium increased the elongation to 10%. 1250C was the

minimum temperature required for deformation of Nb-W-C alloy, Nb-C and Nb-W-C alloys with 0.10% C, vacuum-annealed at 1150 and 1400C, respectively, for 2 hr, had a tensile strength of 30.0 and 58.0 kg/sq mm an elongation of 27.0 and 18.7%. Nb-W-Zr-C alloy with 0.10% C had a tensile strength of 70.0 kg/sq mm and an elongation of 27.8%. The effect of alloying becomes especially pronounced at high temperatures. Author (TAB)

N69-22419# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

PROTECTION OF URANIUM BY METALLIC COATINGS [PROTECTION DE L'URANIUM PAR DES REVETEMENTS METALLIQUES]

Pierre Baque, Philippe Koch, Raymond Dominguet, and Raymond Darras Nov. 1968 36 p refs In FRENCH; ENGLISH summary Presented at the Jubilee Congr. of Soc. Chim. Ind. on Corrosion, Paris, 27–29 May 1968

(CEA-R-3638) Avail: CFSTI

A study is made of the possibilities of inhibiting or limiting, by means of protective metallic coatings, the oxidation of uranium by carbon dioxide at high temperatures. In general, surface films containing intermetallic compounds or solid solutions of uranium with aluminum, zirconium, copper, niobium, nickel or chromium are formed, according to techniques which are described. The processes recommended are direct deposition, or immersion in a molten bath of suitable composition. The conditions for preparing these coatings have been optimized as a function of the protective effect obtained in carbon dioxide at 450 or at 500°C. Only the aluminum and zirconium based coatings are really satisfactory since they can lead to a reduction by a factor of 5 to 10 in the oxidation rate of uranium in the conditions considered; they make it possible in particular to avoid or to reduce to a very large extent the liberation of powdered oxide. The coatings produced generally give the uranium good protection against atmospheric corrosion. Author (ESRO)

N69-22435# Commissariat à l'Energie Atomique, Saclay (France) Centre d'Etudes Nucléaires.

THERMAL DIFFUSIVITY OF SOLIDS [DIFFUSIVITE THERMIQUE DES SOLIDES]

Henri Kleichmann (Inst. Natl. des Sci. Appl.), Yves Fetiveau (Inst. Natl. des Sci. Appl.), Marc Richard (Inst. Natl. des Sci. Appl.), Lucien Eyraud (Inst. Natl. des Sci. Appl.), Jean Elston et al Jan. 1969 44 p refs In FRENCH; ENGLISH summary

(CEA-R-3644) Avail: CFSTI

The different methods of thermal diffusivity measurement and the possible sources of errors are discussed. In particular a study is made of the sinusoidal methods of thermal attack using the measurement of either an amplitude or a phase, in which the controlled energy input is obtained either by the Joule effect or by radiation. The use of controlled systems allows one to measure the thermal diffusivity of the samples over a large range of temperatures. The authors describe their experimental achievements and give several results dealing especially with Al_2O_3, BeO, MgO. Author (ESRO)

N69-22458# Dow Chemical Co., Golden, Colo., Rocky Flats Div.

COMPARISON OF QUANTITATIVE TECHNIQUES FOR ELECTRON MICROANALYSIS OF Pu-Ga AND Pu-Fe ALLOYS

Malcolm R. Harvey and David H. Riefenberg 29 May 1968 8 p refs

(Contract AT(29-1)-1106)

(RFP-1148) Avail: CFSTI

Examination of Pu-Ga and Pu-Fe alloys and compounds was carried out with an electron microprobe. The intensity–concentration relationships in both systems were found to quantitatively obey the empirical Ziebold Ogilvie equation. Utilization of this equation and its experimentally determined conversion parameter gave better quantitative results than those obtained using theoretically determined correction factors. Author (NSA)

N69-22460# Army Materials and Mechanics Research Center, Watertown, Mass.

TITANIUM CARBIDE CONTENT EFFECT ON EROSION IN CERMET ROCKET NOZZLES

Anthony K. Wong and James Brown Oct. 1968 26 p refs

(AD-681920; AMMRC-TR-68-17) Avail: CFSTI CSCL 21/8

Analyses were carried out on subscale cermet nozzles fired in the AMMRC solid propellant engine at a designated maximum chamber pressure of 1100 psi for nominal burning times of 15 seconds in order to determine mechanisms of erosion and the effect of the carbide constituent on erosion. The cermet class investigated consisted of an AISI Type 316 stainless steel matrix incorporating a hard phase of titanium carbide ranging in content from 20% to 55% by volume. The results of the study indicated that under the test conditions, increases in the titanium carbide constituents did increase the erosion resistance of the material. However, this was accomplished at the expense of thermal shock resistance. In addition, the mechanisms of erosion were determined to be thermal-chemical and mechanical in and strength properties followed by the removal of discrete particles by the shearing action of the hot flowing gases. Erosion of the cermet nozzles was both asymmetrical and severe. Their erosion resistance was inferior to that of a lower density, commercial-grade graphite control nozzle tested under the same general conditions. Author (TAB)

N69-22540# Naval Research Lab., Washington, D. C.

HOT CELL EQUIPMENT DEVELOPED FOR REMOTE TENSION TEST SPECIMEN EVALUATIONS AT NRL Final Report

J. Russell Hawthorne and Henry E. Watson Nov. 1968 23 p refs

(AD-682196; NRL-6765) Avail: CFSTI CSCL 11/6

Hot cell equipment and experimental methods for ambient temperature testing of highly radioactive tension specimens are described. Auxiliary equipment developed to aid remote testing includes devices for the following operations: attachment of the specimen extensometer, post-test measurements of the specimen diameter for determining the percent reduction of area and uniform strain, and the measurement of gage length elongation. The device for the continuous sensing of minimum specimen diameter and the system for autographic recording of instantaneous load-minimum diameter from test initiation to specimen failure are described in detail. Author (TAB)

N69-22632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON STRUCTURAL TRANSFORMATIONS IN THE ALLOY E1702

V. V. Karavaeva et al Jun. 1968 20 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk, USSR), v. 8, no. 6, 1966 p 126–134

(AD-681639; FTD-MT-24-162-68) Avail: CFSTI CSCL 11/6

The report discusses the use of an electrical resistance test to investigate the phase transformations occurring in an age hardenable alloy E1702. TAB

N69-22780# Army Materials and Mechanics Research Center, Watertown, Mass.

STRESS CORROSION CRACKING OF TI-8AL-1MO-1V ALLOY IN METHANOL-HYDROCHLORIC ACID SOLUTIONS

Milton Levy and David W. Seitz Nov. 1968 20 p refs
(AD-682008; AMMRC-TR-68-21) Avail: CFSTI CSCL 11/6

Pitting potentials derived from polarization data for Ti-8Al-1Mo-1V in CH3OH, CH3OH-HCl, and CH3OH-HCl-H2O media correlate well with the stress corrosion cracking results. The order of magnitude of activation energy for the temperature-dependent stress corrosion cracking process is in good agreement with a diffusion-controlled reaction, either involving hydrogen diffusion or a mass transport limited reaction involving Cl(-). Controlled potential experiments are consistent with an electrochemical mechanism. Thus, corrosion along an anodic path involving Cl(-) is concluded to be the mechanism of cracking of the alloy in CH3OH-HCl environments. Author (TAB)

N69-22858# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Material- und Festkoerperforschung.
MECHANICAL PROPERTIES OF URANIUM DIOXIDE
G. Engelhardt and H. Hoffmann Feb. 1968 53 p refs In GERMAN
(KFK-729; EUR-3729.D) Avail: CFSTI

The mechanical behavior of UO_2 was found not to be an exceptional case under the oxide ceramic material. The scattering lattice-physical processes were noticeably affected by structure-determined parameters, such as grain size, porosity, and foreign ions. In the studies on the elastic behavior, this effect was registered generally only phenomenologically; a formulation for the atomistic comprehension of the dependencies found is completely lacking. This is not true for the plastic behavior. It is known that the dislocation structure determined the form alteration resistance and the formation and motion of the dislocations depends on the texture state. The creep studies are better interpreted when the absolute values for the creep rates and activation energies deviate sharply from each other. Author (NSA)

N69-22902# Virginia Univ., Charlottesville. School of Engineering and Applied Science.
LATTICE DEFECTS IN QUENCHED NICKEL
James Joseph Laidler (Ph.D. Thesis) May 1968 138 p refs
(Contract AT(40-1)-3108)
(ORO-3108-51) Avail: CFSTI

An experimental effort to observe quenched-in defects in Ni is described. High-purity polycrystalline nickel foils are quenched from a temperature near the melting point into liquid Ga and silicone diffusion pump fluid. The experimental apparatus and procedures are described in detail. Results are presented. NSA

N69-22922# Idaho Nuclear Corp., Idaho Falls.
CORROSION EXPERIENCE WITH TYPE 316 STAINLESS STEEL IN SODIUM-POTASSIUM EUTECTIC ALLOY AT 1400°F
T. L. Hoffman Oct. 1968 37 p refs
(Contract AT(10-1)-1230)
(IN-1185) Avail: CFSTI

Service test examinations were performed on the Type 316 stainless steel loop for circulating sodium–potassium (NaK) eutectic alloy in the Waste Calcining Facility at the Idaho Chemical Processing Plant. These examinations of the stainless steel loop revealed the cumulative effects of 24,300 hours of operation at 1100 to 1400°F during the last six years. Although Type 316 stainless steel performed satisfactorily and is still being used in this service, the results showed that changes in mechanical properties and metallurgical effects occur with circulating nonisothermal NaK in contact with Type 316 stainless steel. Some mass transfer of alloying elements from the hot regions of the Type 316 stainless steel loop to the colder regions was observed. The mitigation of these effects is discussed. Author (NSA)

N69-22923# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JULY THROUGH SEPTEMBER, 1968
Donald L. Keller 1 Oct. 1968 84 p
(Contract W-7405-ENG-92)
(BMI-1851) Avail: CFSTI

Developments are reported for studies on: the fabrication and cladding of UN–PuN fuels for LMFBR applications; radiation effects on fast reactor cladding and structural materials; and creep testing of UO_2 and UO_2–PuO_2 fuel materials. NSA

N69-22957# British Steel Corp., London (England). Metallurgy Div.
OBSERVATIONS ON THE RECOVERY AND RECRYSTALLIZATION PROCESSES IN STEEL Blore Open Report
J. J. Irani, D. Burton, and D. J. Latham 25 Jan. 1968 17 p refs
(PB-180456; MG/C/31/68) Avail: CFSTI CSCL 11F

Recrystallization and recovery can have an influence on the mechanical properties of metals, and this paper is concerned with two examples which apply to structural steels and low alloy steels. The grain size of ferritic steels can be reduced by controlling the size of the austenite grains; however, such a simple relationship is not observed when niobium is present, even in very small amounts the niobium retards the recrystallization of the austenite. A type of thermomechanical treatment, has been developed for the production of very fine ferrite subgrains in low alloy steels. Changes in mechanical properties are correlated with changes in the microstructure, and conditions under which a subgrain structure may be formed and stabilized are discussed. Author (USGRDR)

N69-22993*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC STRAIN AGING DURING THE CREEP AND TENSILE TESTING OF A MOLYBDENUM-TITANIUM-CARBON ALLOY
Peter L. Raffo Washington Apr. 1969 26 p refs
(NASA-TN-D-5169) Avail: CFSTI CSCL 11F

A study was made of the creep and tensile properties of a Mo–0.82 Ti–0.20 C (at. %) alloy in the temperature range 1800° to 3200°F. A peak in the flow stress–temperature curve was noted for this alloy at 1800°F. The strain rate sensitivity of the flow stress was negative in the temperature range 1500° to 2200°F. The creep rate of this alloy above 2400°F has a stress and temperature dependence equal to that of unalloyed molybdenum. At temperatures below about 2400°F, the creep rate at a given stress depends not only on the stress and temperature, but on the entire preloading history. Precipitation occurs on dislocations in specimens crept at 1800°F. It was deduced that the strengthening effects noted during the creep and short time tests are directly related to carbide precipitation during plastic deformation. Precipitation during deformation has two main effects. The first is associated with the decrease in the mobile dislocation density which leads to a greatly decreased creep rate in a constant stress creep test and an increased work hardening rate in a constant strain rate tensile test. Secondly, precipitation during deformation may decrease the rate of recovery. Author

N69-23003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MECHANICAL PROPERTIES AND COLUMN BEHAVIOR OF THIN WALL Be–3Al ALLOY TUBING
Donald R. Rummler Washington Apr. 1969 48 p refs
(NASA-TN-D-5145) Avail: CFSTI CSCL 11F

The results of an experimental investigation to determine the mechanical properties at room temperature and column behavior of commercially produced Be–38Al alloy tubing are presented. The investigation included tubing in both the as-extruded and annealed conditions. Microhardness measurements and metallurgical studies were also performed. Column-buckling loads were predicted by using the tangent modulus, derived from compressive stress-strain curves, in the inelastic column-buckling equation. Author

N69-23084*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPLORATORY STUDY OF SILICIDE, ALUMINIDE, AND BORIDE COATINGS FOR NITRIDATION–OXIDATION PROTECTION OF CHROMIUM ALLOYS

Joseph R. Stephens and William D. Klopp Washington Apr. 1969 28 p refs

(NASA-TN-D-5157) Avail: CFSTI CSCL 11F

Chromium alloys were coated with silicon, aluminum, and boron by pack cementation. None of these simple coatings provided adequate nitridation-oxidation protection for a chromium +0.17 wt % yttrium alloy substrate as shown by a substantial increase in the ductile-brittle transition temperature after air exposure for 100 hr at 2100°F (1420°K). Iron modified silicide coatings afforded good protection, holding the transition temperature of air exposed specimens to 350°F (450°K) compared to 200°F (370°K) for recrystallized uncoated specimens. Additional attractive modifying elements included iron-molybdenum, iron-molybdenum-tungsten, iron-molybdenum-tungsten-titanium, and vanadium-molybdenum-tungsten-titanium. Author

N69-23124# Bettis Atomic Power Lab., West Mifflin, Pa.

PROTECTION OF ZIRCONIUM AGAINST OXIDATION BY MEANS OF METALLIC COATINGS

P. Baque, R. Darras, A. Lafon, and H. Loriers 1968 14 p Transl. into ENGLISH from J. Nucl. Mater. (Amsterdam), v. 25, 1968 p 166–171

(WAPD-Trans-0094) Avail: CFSTI

A protective coating was developed on zirconium and its alloys. It is made of chromium deposited either by thermal evaporation or by electrolysis; a thermal treatment is applied, giving rise to a thin layer of $ZrCr_2$ close to the body, which makes the coating adherent. During a long exposure in carbon dioxide, even under pressure, up to 650°C at least, oxidation is then limited to the growing of a thin impervious film of chromium oxide, which replaces the usual scale of little protective zirconia. Oxygen diffusion in the adjacent body is completely inhibited. The latter property of the coating is explained by its particular composition, which is distinguished by the definite presence of a continuous layer of free chromium on the intermetallic compound. Author NSA

N69-23147# California Univ., Livermore. Lawrence Radiation Lab.

THE DIFFUSION OF SILICON IN α-Fe AND α-Fe–Si ALLOYS

D. Y. F. Lai and R. J. Borg 3 Oct. 1968 9 p refs Sponsored by AEC

(UCRL-50517) Avail: CFSTI

The diffusion coefficients of silicon in α–Fe and dilute Fe–Si alloys were determined as a function of temperature and composition. It was found that Fe–1.8V may be used in place of Fe to maintain the bcc structure over the entire temperature region, the activation energy is essentially independent of composition (up to 4.7% Si), and the diffusivity varies logarithmically with composition, probably only because of the variation in the correlation coefficient. Author (NSA)

N69-23174# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.

RECOVERY OF RHENIUM FROM TUNGSTEN–RHENIUM ALLOY

M. J. Ferrante, F. E. Block, A. D. Fugate, and F. A. Skirvin Apr. 1969 13 p refs

(BM-RI-7254) Avail: Issuing Activity

Rhenium powder was recovered from scrap tungsten alloy containing approximately 25 percent rhenium. Oxidation of the scrap at 950°C separated volatile rhenium heptoxide from tungsten trioxide. Minor amounts of tungsten, iron, and nickel were removed by selective precipitation from a rhenium solution from which crystalline ammonium perrhenate was recovered. Experimentation showed that hydrogen reduction of minus 325-mesh ammonium perrhenate at 1,000°C produced rhenium powder averaging 2.1 microns in size. The powder contained less than 50 ppm of total metallic impurities and 1,070 ppm of total interstitial impurities. Sintered compacts had a density of 95 percent of theoretical. Approximately 96 percent of the rhenium contained in the scrap alloy was recovered. Author

N69-23176# Bettis Atomic Power Lab., Pittsburgh, Pa.

RADIATION-ENHANCED RELAXATION IN ZIRCALOY-4 AND IN A ZIRCONIUM+ 2.5 wt. PERCENT NIOBIUM + 0.5 WT. PERCENT COPPER ALLOY (LWBR DEVELOPMENT PROGRAM)

P. H. Kreyns and M. W. Burkart May 1968 27 p refs

(Contract AT(11-1-GEN-14)

(WAPD-TM-746) Avail: CFSTI

An irradiation-enhanced strain relaxation has been observed in Zircaloy-4 and in a zirconium + 2.5 wt % niobium + 0.5 wt % copper alloy for fast-neutron fluxes of 2.4×10^{14}nv > MeV. The effects of several material and test parameters were investigated, and the results compared with out-of-pile stress relaxation data using a thermally-activated creep model. It was found that in-reactor relaxation of Zircaloy-4 was temperature and structure sensitive, independent of initial stress, and consistent with an accelerated thermal creep model. Author (NSA)

N69-23153# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

CREEP OF ZIRCONIUM FROM 50 to 850 C

E. R. Gilbert Nov. 1968 28 p refs Presented at ASTM Symp. on Appl. Related Phenomenon in Zirconium and Hafnium and their Alloys, Philadelphia, 5–7 Nov. 1968 Submitted for publication

(Contract AT(45-1)-1830)

(BNWL-SA-1959-A; Conf-681105-4) Avail: CFSTI

Uniaxial creep tests have been conducted on polycrystalline alpha zirconium from 50° to 850°C to evaluate the stress and temperature dependence of the second-stage creep rate. From 50° to 300°C, the activation energy for creep was stress-dependent, increasing from approximately 30 to 75 kcal/mole when the stress was decreased from 800 to 400 kg/cm^2. Between 300° and 400°C, the activation energy is approximately 70 kcal/mole. From 400° to 500°C, the activation energy increased from 70 to 105 kcal/mole with decreasing stress. From 500° to 700°C, the activation energy was lower with an average value of 67 kcal/mole which was independent of stress and temperature. From 700° to 800°C, the activation energy was 100 kcal/mole, independent of stress. The apparent activation energy decreased to a very low value above 800°C. This apparent decrease in the activation energy is caused by a structural instability. The creep behavior was somewhat different depending upon whether the specimen was obtained from material fabricated and heat treated in the alpha phase or heat treated in the beta phase. Author (NSA)

N69-23184# Oak Ridge National Lab., Tenn.
EFFECT OF WORKING DIRECTION ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF AN EXTRUDED SAP ALLOY
T. M. Nilsson Dec. 1968 26 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2355) Avail: CFSTI

Bars of commercial SAP 895 sintered aluminum product containing about 10.5 wt % Al_2O_3 were further worked transverse and parallel to the initial extrusion direction. The original extrusion ratio was about 20. The as-extruded structure was very sensitive to transverse working and only extrusion and swaging at high temperature were accomplished in that direction without difficulty. Tensile properties were determined at 450°C in the new working direction. After small amounts of transverse working, properties were low due to the unfavorably aligned structure. At higher reductions the structure became realigned into the new working direction and both strength and ductility exceeded significantly the as-extruded values. Especially noteworthy was the more than doubled uniform elongation after transverse swaging. Further longitudinal extrusion generally increased mechanical properties slightly. The increases in strength were smaller than would be expected from the marked improvements in the dispersion of the oxide phase due to secondary working. Author (NSA)

N69-23218# Bureau of Mines, Albany, Oreg.
PRELIMINARY EVALUATION OF PRE-ALLOYED TUNGSTEN-25 RHENIUM POWDERS Topical Report, 1 Jul. 1965–30 Jun. 1966
Gene Asai and Haruo Kato 24 Aug. 1967 33 p refs
(Contract AT(11-1)-599)
(USBM-RC-1297) Avail: CFSTI

This study was made to characterize co-reduced W-25Re powders prepared at three locations and to determine their suitability for use in the preparation of sintered sleeve extrusion blanks. The particle size and particle size distribution of the as-received powders were determined, and the powders also were analyzed by X-ray diffraction, electron microprobe, chemical and spectrographic methods. Sintering tests were made in the temperature range of 1,500° to 2,400°C. Limited extrusion tests were made for each material. This study showed that the majority of the co-reduced powder particles are actually solid solution particles and that these powders can be consolidated into sleeves using standard powder metallurgy procedures. Several sintered sleeves made from alloy powders produced at each of three locations were successfully extruded at 1,400°C. Author

N69-23260# Lockheed Missiles and Space Co., Palo Alto, Calif.
RADIATIVE PROPERTIES OF TANTALUM, MOLYBDENUM, NIOBIUM, GRAPHITE AND NIOBIUM CARBIDE AT HIGH TEMPERATURES
B. A. Khrustalev et al [1968] 23 p refs Transl. into ENGLISH of the book "Teploobmen, Gidrodin. i Teplofizich. Svoistv Veshchestva" Moscow, Nauka Press, 1968 p 198–219
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Various radioactive properties of a number of heat resistant materials are studied at the high temperatures needed for practical utilization in engineering computations. They are compared with existing data on the degree of blackness of other investigations, and with some theoretical dependences. Methods were developed for the experimental investigation of the following radioactive characteristics: Normal integrated degree of blackness, normal spectural degree of blackness in the 1–6.5 μm infrared range, at the 0.385, 0.465, 0.655 μm visible wavelengths, and the distribution of the spectral degree of blackness of different directions to the radiating surface at the 0.65 μm wavelength. An exposition of the measurement method and a description of the special apparatus is given. Author

N69-23311# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRON-BEAM MELTING OF VARIOUS METALS (ASSORTED LEAFLETS)
21 Feb. 1968 17 p Transl. into ENGLISH from Leaflets Published by Inst. Elektrosvarki (Kiev), 1965
(AD-682235; FTD-HT-23-1624-67) Avail: CFSTI CSCL 11/8

Contents: Electron-beam-melted niobium; Electron-beam-melted nickel; Electron-beam-melted copper; Sh0h-15 electron-beam-smelted steel; U-270 electron beam apparatus for melting metals and alloys; and Election-beam-melted tantalum. TAB

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-21985 Akron Univ., Ohio.
THE STRUCTURE OF SULFUR VULCANIZATES OF SBR AND HEVEA RUBBER
Leong Ming Gan (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-13536

Determination of the crosslinking density by either or both equilibrium swelling and stress-strain measurements has been used in conjunction with chemical probes to elucidate the sulfidic structural features in unaccelerated, as well as accelerated, gum vulcanizates for both SBR and natural rubber. In general, SBR-S vulcanizates have similar sulfidic structures as in NR-S-vulcanizates, i.e., if an NR-system contained mainly polysulfidic or monosulfidic crosslinks, then this was found to be true also in the SBR-system. The vulcanizates of SBR-DPG-S with the same network chain density but with various polysulfidic crosslink lengths do not show any appreciable difference in tensile strength when corrected for temperature and strain rate effects. Dissert. Abstr.

N69-22080 Missouri Univ., Rolla.
INTERNAL FRICTION OF MIXED-ALKALI SILICATE GLASSES
James Elbert Shelby, Jr. 1968 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-14045

The mixed alkali effect in silicate glasses was examined from internal friction measurements made over the temperature range from −190 to 500°C and at a frequency of 0.4Hz. Supplemental measurements of the activation energy for the different internal friction peaks, dynamic shear modulus, density, and index of refraction were also made. All measurements were confined to silicate glasses. Rötger's interpretation of the internal friction of mixed alkali silicate glasses is shown to be incorrect. A previously unreported internal friction peak was observed whenever two different alkali oxides were present simultaneously. The behavior of this peak in the different mixed alkali glasses is more easily correlated with the radius ratio of the two alkali ions present than with the mass ratio. A stress induced alkali ion position interchange is suggested as the probable mechanism responsible for this peak. Dissert. Abstr.

N69-22098 Akron Univ., Ohio.
MECHANISM OF REINFORCEMENT OF AMORPHOUS ELASTOMERS BY PARTICULATE FILLERS
James Churchill Healy (Ph.D. Thesis) 1967 248 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 68-13537

A study was carried out on filler reinforcement of SBR using model glass polymeric fillers of particle size 200A to 6500A. SBR and polystyrene lattices were blended, coagulated, and vulcanized below the glass transition temperature of the filler. Polymer–filler bonding was controlled by varying the amount of unsaturation (by copolymerization with butadiene) in the filler. The presence of bonding was verified by loss of solubility of the filler. Electron photomicrographs showed excellent dispersion of the individual filler particles. Uniaxial tensile strength measurements, carried out over a range of temperatures and strain rates, showed that the fillers increased the tensile strength of the vulcanizate at any given temperature and strain rate by increasing the viscoelasticity of the matrix. This effect varied directly with filler content, but inversely with particle size. Increased chemical filler-elastomer bonding decreased slightly the tensile strength at any given filler level. Dissert. Abstr.

N69-22145 Iowa State Univ. of Science and Technology, Ames.
STABILIZATION OF THE PHASE TRANSFORMATIONS IN HAFNIUM OXIDE
John Dennis Buckley (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-14775

The need for thermal shock resistant refractories, used as structures or as a protective coating on aerospace vehicles, initiated an investigation of HfO_2 – CaO, HfO_2 – Y_2O_3, and HfO_2 – MgO solid solutions. This included: (1) investigation of the effect of time and temperature on the solubility of oxide additions to hafnia; (2) analysis of composition changes resulting from sintering at several temperatures for varying times; (3) determination of the lattice parameters of cubic phase hafnia characteristic of each of the solid solutions; (4) examination of phase transformations and the solid solubility of the oxide stabilizer additions by high temperature X-ray diffraction; (5) correlation of metallographic and X-ray analyses to allow visual identification of phase and grain boundary composition; (6) determination of the effect of cyclic heating on the stability of solid solutions; and (7) observation of the effects of thermal shock on partially and fully stabilized hafnia. It was found that sintering temperature and/or sintering time influence the solubility of calcia, yttria or magnesia in hafnia, and that unit cell dimensions of stabilized hafnia bodies are influenced by the oxide addition in solid solution. Yttria stabilized hafnia bodies maintain their stability, whereas, magnesia and calcia stabilized specimens destabilize when subjected to a single heat cycle. X-ray diffraction and electron microprobe X-ray analysis permitted visual identification of the phases present in the grains and grain boundaries of the hafnia solid solutions. The overall thermal shock resistance of yttria stabilized hafnia, quick cooled in ambient air from temperatures up to 2000°C, was superior to hafnia stabilized with calcia or magnesia. The solid solutions that exhibited the best resistance to thermal shock were hafnia highly stabilized with calcia or yttria. Dissert. Abstr.

N69-22262*# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
FAILURE CRITERIA FOR VISCOELASTIC MATERIALS Quarterly Progress Report
W. G. Knauss Mar. 1969 9 p refs
(Grant NGL-05-002-005)
(NASA-CR-100537; GALCIT-SM-69-3) Avail: CFSTI CSCL 11I

The role of surface energy in steady state crack propagation is considered from the microscopic and macroscopic point of view. A general crack propagation law is presented for arbitrary geometries under arbitrary loads; application is demonstrated in the special case of crack propagation in an infinite strip, with the only variation in the stress intensity factor arising from the variation of the applied strain. The planned application of a prediction theory to solid propellants, growth of a crack in the vicinity of a circular inclusion in a sheet, and crack growth in a shear field are also briefly discussed. K. W.

N69-22346# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE Quarterly Progress Report, Period Ending 14 Feb. 1968
J. C. Bokros, G. B. Engle, and R. J. Price 21 Feb. 1968 50 p refs
(Contract AT(04-3)-167)
(GA-8538) Avail: CFSTI

The properties and structure of the various types of carbons and graphites required for use in high-temperature nuclear reactors of advanced design are studied. Emphasis is placed on defining the structures of the various carbons and graphites, defining the relationships between structure and relevant properties, and evaluating methods for the preparation of improved structure. Subjects included are: (1) structure of carbonized coal-tar pitch, (2) characterization of degree of graphitization, (3) catalytic graphitization of binder-filler artifacts, (4) irradiation behavior of graphites, (5) radiation-induced dimensional changes in single-phase pyrolytic carbons and graphites, (6) annealing studies of pyrolytic-carbon structures. NSA

N69-22396# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DENSITY AND ELECTRICAL CONDUCTIVITY OF MOLTEN SALTS. COMPARATIVE STUDY OF BINARY MIXTURES OF ALKALI NITRATES WITH SILVER NITRATE AND WITH THALLIUM NITRATE [DENSITE ET CONDUCTIBILITE ELECTRIQUE DE SELS FONDUS. ETUDE COMPARATIVE DES MELANGES BINAIRES NITRATES ALKALINS-NITRATE D'ARGENT ET NITRATES ALCALINS-NITRATE DE THALLIUM]
Serge Brillant (Ph.D. Thesis—Strasbourg Univ., 27 Oct. 1967) Dec. 1968 79 p refs In FRENCH; ENGLISH summary
(CEA-R-3545) Avail: CFSTI

The choice methods and the number of measurements made enable one to obtain results on the density and electrical conductivity of molten binary mixtures, alkali nitrate and silver nitrate, and alkali nitrate and thallium nitrate, in the form of equations. The deviations from linearity of the volume and the molar conductivity are determined by calculating the corresponding excess values whose variations are analyzed as a function of the Tobolsky parameter. The absence of any relationship in the sign of the entropy and the excess volume is justified. It is shown that the silver and thallium nitrates, in contrast to the thermodynamic properties, behave as alkali nitrates in so far as the excess conductivity is concerned. This result is confirmed by the study of changes in the activation enthalpy for the partial molar conductivity; this study also shows the particular behavior of lithium nitrate. Author (ESRO)

N69-22609# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
MAGNETIC RESONANCE STUDIES OF SOLID POLYMERS [ETUDE DES POLYMERES SOLIDES PAR RESONANCE MAGNETIQUE]
Rudolf Lenk Jan. 1969 45 p refs In FRENCH; ENGLISH summary
(CEA-R-3681) Avail: CFSTI

This paper is a review of the application of nuclear magnetic resonance (NMR) to solid polymers. In the first, theoretical part,

the elements of the theory of NMR, which are necessary for the study of the properties of solid polymers are discussed e.g. the moment method, nuclear relaxation and the distribution of correlation times. In the second part the experimental results are presented.
Author (ESRO)

N69-22785*# Boeing Co., Seattle, Wash. Aerospace Group.
DEVELOPMENT OF LIQUID OXYGEN COMPATIBLE ADHESIVE SYSTEM, PART 2 Final Report, Jul. 1968-Dec. 1968
Jose G. Shdo and J. T. Hoggatt Dec. 1968 54 p refs
(Contract NAS3-7952)
(NASA-CR-72502) Avail: CFSTI CSCL 11A

An adhesive system that is compatible with liquid oxygen and is suitable for Kapton film bladder fabrication is selected, developed, and evaluated. Initially nine adhesives were selected for further screening for bonding Kapton film for use in liquid oxygen (LOX) applications. The screening process consisted of the following: (1) adhesive bonding strength with Kapton, (2) compatibility with LOX under impact, and (3) adequate flexibility at -320°F. Kel-F elastomeric adhesive was the final selection for LOX bladder usage.
Author

N69-23145# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE Quarterly Progress Report, 15 May-14 Aug. 1968
J. C. Bokros, G. B. Engle, and R. J. Price 1 Sep. 1968 23 p refs
(Contract AT(04-3)-167)
(GA-8852) Avail: CFSTI

The effects of aluminum on catalytic graphitization were studied. The graphitization of aluminum- and titanium-containing asphalt and coke was investigated. The annealing of titanium-doped pyrolytic carbon was accomplished, and the effects of neutron irradiation on the resulting dimensions are presented. The graphitization and densitometric characterization of graphite are described, along with the property changes induced by annealing of irradiated pyrolytic graphite and the neutron irradiation effects on the density of CHN and H-315-A graphites. The effects of fast neutron irradiation on graphites and carbons were studied, as were the effects of titanium on catalytic graphitization.
NSA

N69-23327# IIT Research Inst., Chicago, Ill.
SWIMM CODE: STRESS WAVE PROPAGATION IN ELASTIC-PLASTIC-COMPACTIBLE MEDIA, VOLUME 4 Final Report
John B. Eichler Aug. 1968 192 p
(Contract AT(11-1)-578)
(IITRI-578-P-21-10-Vol-4) Avail: CFSTI

The SWIMM code was written in FORTRAN 2 for use on an IBM 7094 high speed digital computer. Its purpose is to calculate one dimensional uniaxial stress wave attenuation in layered materials containing from one to forty layers. The general manner in which the code was written provides a valuable tool for the analysis of such stress wave problems. A summary of the application of the equations used, a discussion of the objective of each SWIMM code subroutine, and the instructions for using the SWIMM code are included. Also included is a listing of the SWIMM code. One solved problem is presented. For Vols. 1, 2, and 3, see: N68-27417, N68-17082, and N68-87346, respectively.
Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory, and numerical analysis. For applications see: 08 Computers.

N69-21954 Texas Univ., Austin.
INFINITE SERIES TRANSFORMATIONS AND THEIR APPLICATIONS
William Dean Clark (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-10820

A non-linear transformation for evaluating infinite series and sequences is studied. A number of theorems are established which enhance the ability to make intelligent use of the transformation. In particular, special attention is given to those cases for which the use of the transform is questionable. The results are also exemplified.
Dissert. Abstr.

N69-21955 Stanford Univ., Calif.
OPTIMAL CONTROL OF A DYNAMIC SYSTEM BY TWO CONTROLLERS WITH CONFLICTING OBJECTIVES
Ian Borton Rhodes (Ph.D. Thesis) 1968 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-11340

Consideration is given to both deterministic differential games with perfect information and stochastic games in which the two controllers have only incomplete and noise-corrupted information about the system state. In the former case the differential game problem is reformulated as a constrained optimization problem in Hilbert space, so that different system types such as continuous-time systems and discrete-time systems are simultaneously included in a single abstract formulation. Considerable emphasis is placed on various examples involving a linear system and a quadratic cost functional, with and without control constraints. Attention in the examination of stochastic differential games of imperfect information is directed primarily towards a number of problems involving a continuous-time linear system, a quadratic cost functional and independent white Gaussian noises additively corrupting the output measurements.
Dissert. Abstr.

N69-21961 Illinois Univ., Urbana.
CONFORMAL VECTOR FIELDS ON COMPACT RIEMANNIAN MANIFOLDS
Waldemar Carl Weber (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-12219

Let M be a connected differentiable manifold with riemannian metric g. Then g determines the local geometry on each coordinate neighborhood of the riemannian manifold (M,g). A conformal transformation on (M,g) is a diffeomorphism of M which reproduces g up to a positive scalar factor that is allowed to vary smoothly from point to point. Conformal transformations have the property that they preserve the angle formed by any two tangent vectors at any given point of (M,g). (M,g) which reproduces g is an isometry of (M,g). Geometry-in-the-large on a riemannian manifold (M,g) is derived from the local geometry determined by g and from various topological properties of a global nature which may be ascribed to M. Assuming that M is compact as well as connected, we are concerned with the problem of determining the global geometry of (M,g) from a knowledge of its curvature properties and from the existence of a 1-parameter group of conformal non-isometric transformations.
Dissert. Abstr.

N69-21962 Texas Univ., Austin.
PRODUCTION CONTROL USING IMPERFECT INSTRUMENTATION ANALYZED AS A PARTIALLY OBSERVABLE MARKOV PROCESS
Alfred Ellis Traver, Jr. (Ph.D. Thesis) 1968 198 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-10892

The study of the conditional statistical properties of a process is simplified when the process is treated as a Markov process. Analytically, this means that only lowest order correlations are taken into account. Many physically realizable processes are adequately described by a Markov process model. The consideration of only low-order correlations is not, in principle, very restrictive since higher order correlations could be considered by complicating the Markov process, if necessary. This study will be concerned with means of improving the accuracy of an imperfect monitor in those instances where the process being monitored is found to be well modeled by a simple Markov process. The techniques developed are applied to a monitoring effect to ascertain the quality of the output of a production process with regard to its suitability for sale.
Dissert. Abstr.

N69-21995# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TOWARD A THEORY OF APPROXIMATELY MINIMAX DETECTION OF SIGNALS AGAINST A GAUSSIAN BACKGROUND
Yu. V. Linnik, Yu V. Prokhorov, and O. V. Shalaevskii May 1968 22 p refs Transl. into ENGLISH from Teoriya Veroyatnostei i ee Primeneniya (Moscow), v. 12, no. 3, 1967 p 401–417
(AD-681594; FTD-HT-23-246-68) Avail: CFSTI CSCL 9/4

The author seeks a solution to the problem of detecting a signal characterized by a p-dimensional vector having a given relative energy in the presence of background p-dimensional Gaussian noise with zero average value and unknown energy. TAB

N69-22015 Texas Univ., Austin.
AN ADAPTIVE MULTICATEGORY PATTERN CLASSIFICATION SYSTEM
James Michael Pitt (Ph.D. Thesis) 1968 105 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-10879

An adaptive, multicategory, pattern classification system for classifying statistical patterns is formulated and the basic format of the system is described. The convergence rate and other special properties of the system are examined, including the special case where the expected loss due to misclassification by the system tends to the minimum expected loss which results when using the Bayes discriminant functions. A simulation of the system for a three-category problem using quadratic discriminant functions is presented.
Dissert. Abstr.

N69-22027 California Univ., Los Angeles.
FUNCTIONAL ANALYTIC ANALYSIS OF THE PURSUIT PROBLEM OF KELENDZERIDZE
Rahul Chattopadhyay (Ph.D. Thesis) 1968 31 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-11862

The present dissertation is concerned with the analysis of a pursuit problem. The techniques of functional analysis are used for this purpose. The pursuit problem considered here was formulated by Kelendzeridze. The author applies basic results of the theory of moments to this problem. A critical analysis of the assumptions made by Kelendzeridze leads to the introduction of the concept of interceptibility. This concept is closely related to the concept of completion of linear differential games as introduced by Pontryagin. Several necessary and sufficient conditions for interception are presented. An estimate of the set of initial states of the pursuer from which interception is possible, is provided. Following Kelendzeridze, the concepts of optimal pursuit time and optimal pursuit strategies are introduced. Methods of determining the optimal pursuit times and optimal pursuit strategies are also presented.
Dissert. Abstr.

N69-22064 Case Western Reserve Univ., Cleveland, Ohio.
SOME CONSEQUENCES OF THE PROPERTIES OF THE INTERNAL SYMMETRY CROSSING MATRICES
Herbert Kottler (Ph.D. Thesis) 1967 185 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-10166

The general properties are investigated of the internal symmetry crossing matrices for an arbitrary compact internal symmetry group. Then the consequences are considered of these properties in three problems where the crossing matrices play an important role. In the first, a statistical model is formulated for high energy, large angle two-particle scattering with which one can calculate average branching ratios. The crossing matrices enter into this model through the requirement that the average cross section be independent of the channel through which one views the reaction. Next, a u-channel dominance theorem is proved, which, in essence, states that the only single internal symmetry reduced amplitude that can dominate the u-channel contribution to an s-channel process is that reduced amplitude which corresponds to the maximum weight representation in the u-channel. Finally, the role which the elements of the crossing matrices play in a simple self bootstrap model for a scalar particle is studied.
Dissert. Abstr.

N69-22069 Texas Univ., Austin.
REGULAR BOREL MEASURES ON COMPACT SPACES
John Wellden Hardy, Jr. (Ph.D. Thesis) 1968 63 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-10941

This is an investigation of regular Borel measures defined on arbitrary compact Hausdorff spaces. For nonatomic regular Borel measures, perfect subsets of the space play a fundamental role. If m is a nonatomic regular Borel measure, and E is a Borel set such that m(E) is positive, then for every positive real number t less than m(E), there is a perfect subset P of E such that m(P) = t. Other new results are: an equivalence between the extension of certain regular Borel measures and the extension of certain positive linear functionals; and characterizations of Cantor spaces and the Cantor set. These are used to prove the known result that a compact Hausdorff space has a non-trivial nonatomic regular Borel measure if and only if it has a nonempty perfect subset.
Dissert. Abstr.

N69-22070 Houston Univ., Tex.
AN INVESTIGATION OF COUNTABLY PARACOMPACT SPACES AND RELATED TOPICS
Phillip Lee Zenor (Ph.D. Thesis) 1968 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-11153

The relationships between countably paracompactness and normality are studied. A property called paranormality, which is an extension of the notion of countable paracompactness is discussed. Paranormality is applied to some problems related to the metrization of developable spaces. Upper semicontinuous decompositions of countably paracompact spaces, normal spaces, and Moore spaces are considered.
Dissert. Abstr.

N69-22085 Wisconsin Univ., Madison.
INERTIA THEORY FOR OPERATORS ON A HILBERT SPACE
Bryan Edmond Cain (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-90604

An operator A on a real Hilbert space H is inertial if and only if its extension A_c to H_c, the complexification of H, is inertial. Then In(A) is defined to be In(Ac). This definition generalizes the one given for matrices by Ostrowski and Schneider and yet it permits many of the same theorems. The positive Hermitian operators form a cone in the real Banach space of Hermitian operators. When A lies in the interior of this cone $A > > 0$. Dissert. Abstr.

N69-22096 Case Western Reserve Univ., Cleveland, Ohio.
STRUCTURE GRAMMARS
Richard Earl Hammer (Ph.D. Thesis) 1967 81 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-10162

The analysis of grammars and languages has heretofore often leaned heavily upon informal arguments involving tree structures. Structure grammars retain the intuitive power of analysis of tree structures, yet have the advantage of being easily formalized. A structure grammar G_s for the grammar G is a homomorphic pre-image of G. Natural, sufficient conditions are bound on G_s that imply $\pi(=>_s) = =>$, where π is the homomorphism mapping G_s onto G and $=>_s$, $=>$ are the grammatical closures of the production relations of G_s, G respectively. A scheme for constructing a particular type of structure grammar, called a right-bracket structure grammar is formalized and then, as applied to context free grammars, studied in detail. Ambiguity with respect to a structure grammar is defined, both in a global and local sense. To aid in the isolation of local ambiguities, slices and essential slices are defined. Dissert. Abstr.

N69-22099 Nebraska Univ., Lincoln.
NATURAL DEDUCTION AND UNIVERSAL VALIDITY
David Franklin Fox (Ph.D. Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-11553

A study is made of the concept of universal validity, that is, validity in all individual domains, including the empty individual domain. A procedure is given by means of which any formula can be tested with regard to its validity in the empty domain. In particular, it is shown that any open formula, any universally closed formula, and the negation of any existentially closed formula are valid in the empty domain. In addition, a calculus of natural deduction is developed which is shown to be universally sound and universally complete, so that the class of formulas which are deducible in this calculus of natural deduction coincides with the class of formulas which are valid in all individual domains, including the empty domain. Dissert. Abstr.

N69-22136 California Univ., Irvine.
APPLICATIONS OF ALGEBRAIC REPRESENTATION THEORY
William George Harter (Ph.D. Thesis) 1967 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-11030

In this dissertation the theorems of representation theory of finite groups are proved using a line of reasoning that is the reverse of that found in standard texts. This approach yields a very clear picture of the structure of irreducible representations, and motivates a very efficient method for solving certain types of matrix equations and deriving Clebsch Gordon coefficients. The approach uses certain properties of the Hamilton Cayley equations of matrices which are themselves not very well known but very useful for dealing with matrix equations. These developments are written so they may be read by someone who has had very little contact with matrix equations or the theory of algebras in general. Dissert. Abstr.

N69-22137 State Univ. of New York at Buffalo.
THE SOLUTION OF THE DISCRETE QUADRATIC CONTROL PROBLEM BY SPECTRAL FACTORIZATION
Paul Raymond Motyka (Ph.D. Thesis) 1968 167 p
Univ. Microfilms: HC $7.80/Microfilm $3.00

This dissertation deals with the solution of the discrete quadratic control problem i.e., given the state variable representation of a discrete system, find the stable and nonanticipatory control vector sequence which minimizes a quadratic performance index. Both stable and unstable plants are considered. The specific tool used in the solution is spectral factorization. This being the case, the technique of factoring the spectral matrices of continuous systems, as developed by M. C. Davis, is adapted to discrete systems. Attention is then focused on the quadratic control problem for stable plants. A necessary and sufficient condition for a minimum of the quadratic performance index is obtained and it is shown how the tool of spectral factorization can be utilized to determine the optimum control vector sequence. These same items are then shown for the unstable plant case. Dissert. Abstr.

N69-22161 Yeshiva Univ., New York.
INVARIANTS OF FINITE REFLECTION GROUPS
Margaret Mary Wiener (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-10991

Proof is given for the statement that the invariants of a finite group acting on a dimensional vector space over a field of characteristic zero have an integrity basis of invariants. A method is given for computing the degrees of the members of the basis. The construction of a basic set of invariants is shown to be related to the solution of a certain mean value problem. Considerations of this mean value problem lead to a conjecture yielding an explicit construction of a basic set of invariants. The conjecture is verified for most of the irreducible finite reflection groups. Dissert. Abstr.

N69-22166 Case Western Reserve Univ., Cleveland, Ohio.
MULTILAYER APPROACH TO ADAPTIVE OPTIMIZING CONTROL UNDER DISTURBANCES
Kiyotaka Shimizu (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-10183

The adaptive-optimizing control of systems subject to external disturbance inputs is studied in the context of a multilayer approach. The systems represented are essentially deterministic, nonlinear, continuous-type processes which are normally operating in the steady-state. The objective is online static optimization according to an economic performance criterion. An on-line algorithm yields a suboptimal control input to the process as a function of the measured disturbance inputs. The parameters of the control algorithm are periodically updated so as to maximize the expected system performance. Two approaches to the optimization are considered. (1) Adaptive control by stochastic optimization. (2) Optimal satisfactory control. The former requires some knowledge of the probability distribution of the disturbances; the latter does not. Dissert. Abstr.

N69-22177 Iowa Univ., Iowa City.
DYNAMIC AND INTEGER PROGRAMMING APPROACHES TO THE SELECTION OF PATTERN FEATURES
Gerald Duane Nelson (Ph.D. Thesis) 1968 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-10679

This thesis concerns the optimal selection of a subset of features from a set (1) where two pattern classes are to be distinguished, and (2) where multiple pattern classes are to be distinguished. In each of the cases, the optimization problem is considered first for a single constraint, and then the extension to two or more constraints is given. The formulation as a dynamic programming problem permits an optimal solution to feature selection problems which previously were uncomputable by exhaustive search methods. This mathematical model permits the study of interactions among the constraints and the probability of correct classification, thus illustrating the advantages of dynamic programming. Conceptually, the dynamic programming approach can be extended to problems in which several constraints limit the selection of features, but the computational difficulties become dominant as the number of constraints increase beyond two or three. To solve the three and more constraint problems integer programming techniques are used. Many of the concepts developed in connection with the two-class problem can be extended to the situation where three or more classes are to be distinguished (the multi-class case). Significant modifications are required to obtain useful return functions. The problem areas associated with the multi-class case are highlighted. Dissert. Abstr.

N69-22290# Naval Personnel Research Activity, San Diego, Calif.
NORMIX PROGRAM DOCUMENTATION
John H. Wolfe Dec. 1968 84 p refs
(AD-682213; NPRA-SRM-69-11) Avail: CFSTI CSCL 12/1

The report describes the operation and use of program NORMIX - a method of cluster analysis and unsupervised pattern recognition. The program takes the scores or measurements of as many as 1000 individuals or objects and groups them into different types under the assumption that each type has a multivariate normal distribution of the scores. Complete program listings and illustrative printouts for the Fisher Iris data are included.
Author (TAB)

N69-22311# Wisconsin Univ., Madison. Dept. of Statistics.
NONPARAMETRIC ESTIMATION OF THE TRANSITION DISTRIBUTION FUNCTION OF A MARKOV PROCESS
George G. Roussas Jun. 1968 38 p refs
(Grant NSF GP-8884)
(PB-180698; TR-160) Avail: CFSTI CSCL 12A

In a previous report the problem of nonparametric estimation in Markov processes has been considered, and estimates of the initial, two-dimensional joint, and transition densities of the process, satisfying a number of optimal properties, have been obtained. In the present paper, under the same nonparametric setup, the attention is centered primarily on the transition distribution function of the process.
USGRDR

N69-22398# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugmechanik.
INVESTIGATION OF HILL'S ZERO VELOCITY SURFACES OF THE RESTRICTED THREE-BODY PROBLEM WITH REGARD TO FAR EARTH ORBITS, ESPECIALLY PLANE TWENTY FOUR-HOUR ORBITS [EINE UNTERSUCHUNG DER HILL'SCHEN GRENZFLAECHEN DES RESTRINGIERTEN DREIKOERPERPROBLEMS IM HINBLICK AUF ERDFERNE BAHNEN, INSBESONDERE EBENE 24h-BAHNEN]
Kl.-H. Well Apr. 1968 29 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-14) Avail: CFSTI

It is shown that a first integral of the equations of motion of the restricted three-body problem exists even in case the potential functions of both the finite masses are symmetrical and the axes of symmetry are normal to the plane of motion of the finite masses. For a 24h-satellite Hill's zero velocity curves are calculated and it is shown by means of numerical investigation that the influence of the Earth's oblateness on the position of the zero velocity curves is very small. It has become evident that a 24h-satellite cannot escape from a certain region around the Earth.
Author (ESRO)

N69-22428# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugführung.
CALIBRATION OF A COMPARATOR FROM THE MEASUREMENT OF ANY SPREAD POINT AREA WITH THE DETERMINATION OF THE CORRECTED COORDINATES [EICHUNG EINES KOMPARATORS AUS DEN MESSUNGEN EINES BELIEBIG VERTEILTEN PUNKTFELDES MIT BESTIMMUNG DER KORRIGIERTEN KOORDINATEN]
U. Brokof Mar. 1968 27 p refs In GERMAN; ENGLISH summary Sponsored by BMwF
(Contract RFF 2012)
(DLR-FB-68-71) Avail: CFSTI

For the investigation of the three most important errors of the Asco-record-monocomparator and for a precise determination of coordinates, a method was chosen that combines the coordinates of glass plate points measured in four different positions. Formulas are derived that lead to the determination of three values for the correction angle of nonperpendicularity $d\beta$ of the guide ways and to one for the difference dm of the x- and y-scales, all values directly obtainable by least squares adjustment. The curvatures of the x- and y-guide ways are determined from residuals by using polynomials. Finally mean coordinates are obtained corrected by the errors previously computed. In the shown way, 126 points of a grid plate were calibrated. The standard deviation of the mean coordinates was $\varepsilon = 0.4\mu$. The values for $d\beta$ and dm are : $d\beta$ (mean) = $+ 0.25'' \pm 0.15''$; dm = $(-3.1 \pm 1.0) \cdot 10^{-4}$
Author (ESRO)

N69-22436# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
A CLASS OF EXACT SOLUTIONS FOR THE VLASOV-TURBULENCE
Pitter Graeff Nov. 1968 21 p
(MPI-PAE/PL-8/68) Copyright. Avail: Issuing Activity

The admissible closure conditions can be completely determined in the limit of vanishing correlation length. In this case the Lundgren hierarchy can be solved, since this irregular state persists in the course of time. The electric field on the other hand loses its statistical character. The results can be extended to examples of homogeneous turbulence with a finite correlation length.
Author (ESRO)

N69-22551*# Techtran Corp., Glen Burnie, Md.
APPROXIMATE SOLUTION OF DIFFERENTIAL EQUATIONS
Hikoji Yamada Washington NASA Apr. 1969 9 p refs Transl. into ENGLISH from Rept. of Ryutai-Kogaku Kenkyusyo (Japan), v. 3, no. 3, 1947 p 29-35
(Contract NASw-1695)
(NASA-TT-F-12170) Avail: CFSTI CSCL 12A

A well known moment theory is used in the selection of a differential equation. A tentative method is given for calculation

of the degree of approximation of an approximate solution of g(x). Details of methods of application are given for a few examples in ordinary differential equations, and partial differential equations.
Author

N69-22812# Oak Ridge National Lab., Tenn.
PRIME NUMBERS TREATED AS A MARKOV CHAIN
V. R. Rao Uppuluri Aug. 1968 12 p refs
(Contract W-7405-ENG-26)
(PB-180746; ORNL-TM-2317) Avail: CFSTI

The set of prime numbers is treated here as a random phenomenon. In a deterministic set up, the fact that we know the largest prime number does not throw any light on the next prime number. But by imbedding an ergodic Markov chain in the phenomenon of primes we will indicate how one can give odds that the next prime ends in 1, 3, 7 or 9. This is based on the important fact that though one cannot observe a random prime number, one can make observations on random transitions between primes.
Author (USGRDR)

N69-22847# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STOCHASTIC OPTIMIZATION: OPTIMAL CONTROL AND ESTIMATION OF LINEAR SYSTEMS WITH GAUSSIAN PERTURBATIONS [OPTIMISATION STOCHASTIQUE: OPTIMASATION DE LA COMMANDE ET ESTIMATION DE L'ETAT DE SYSTEMES LINEAIRES A PERTURBATIONS GAUSSIENNES]
Claude Aumasson 1968 69 p refs in FRENCH; ENGLISH summary
(ONERA-NT-133) Avail: CFSTI

The systems studied present a discrete time evolution. The dynamic programming method is first extended to stochastic problems. It is then applied to linear systems perturbed by additive, Gaussian and non-memorized noises. To do this, it is necessary to establish first some results on the estimation of Gaussian and Markovian processes defined by recursive linear equations. A decoupling between optimization and estimation is observed.
Author

N69-22867# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
ON THE STABILITY OF NON-LINEAR SYSTEMS [SUR LA STABILITE DES SYSTEMES NON-LINEAIRES]
Mauricio Guelman (Paris Univ.) Sep. 1968 59 p refs in FRENCH; ENGLISH summary
(CEA-R-3593) Avail: CFSTI

A study is made of the absolute stability of non-linear systems, using Liapounov's second method and taking into account the results obtained from V.M. Popov's work. Work concerning the frequency domain criterions for the absolute stability of automatic control systems containing one single non-linearity have been extended to show the existence of a limiting parabola. Absolute stability criterions for a system containing a different type of non-linearity are also derived. Finally, the results are considered from the point of view of Aizerman's conjecture.
Author (ESRO)

N69-22870# Wisconsin Univ., Madison. Dept. of Statistics.
WEIGHTED LEAST SQUARES WHEN THE VARIANCE AND EXPECTED VALUE OF THE DEPENDENT VARIABLE ARE RELATED
George E. P. Box and William J. Hill Feb. 1968 24 p refs
(Grant NSF GP-2755)
(PB-180695; TR-142) Avail: CFSTI CSCL 12I

An iterative method for obtaining weights is proposed. One case where this method may be applied occurs when a nonlinear model is linearized by transforming the original dependent variable, and the resulting linear model is then used in the regression analysis. If the original dependent variable has constant variance, then it is almost certainly true that the transformed variable has not and will need to be weighted accordingly. An example is given where a nonlinear chemical rate expression is linearized and then is fitted using this iterative method.
Author (USGRDR)

N69-22871# Wisconsin Univ., Madison. Dept. of Statistics.
CHARTS FOR THE INTERPRETATION OF LOW ORDER AUTOREGRESSIVE-MOVING AVERAGE MODELS
C. M. Stralkowski and S. M. Wu Jun. 1968 70 p refs
(Grant NSF GK-1695)
(PB-180699; TR-164) Avail: CFSTI CSCL 12A

The purpose of this paper is to graphically illustrate and relate the patterns in the series, the correlation and partial correlation functions, and the forecast functions of low order stationary and non-stationary models. To provide a qualitative insight into the types of series which models involving three or fewer parameters can represent, simulated series were generated for representative parameters within the admissible parameter region. The characteristics of the series are graphically related to the patterns exhibited by the forecast and correlation functions. Charts illustrating the relationship between the roots and parameters of models involving three or fewer autoregressive and/or moving average parameters are provided to assist in the interpretation.
Author (USGRDR)

N69-22874# Wisconsin Univ., Madison. Dept. of Statistics.
ASYMPTOTIC EXPANSIONS ASSOCIATED WITH POSTERIOR DISTRIBUTIONS
Richard A. Johnson 1968 34 p refs
(Grant NSF GP-6519)
(PB-180696; TR-146) Avail: CFSTI CSCL 12A

An extension of the investigation of Johnson (1967b) is made by giving a larger class of posterior distributions which possess a symptotic expansions having a normal distribution as a leading term. Asymptotic expansions for the related normalizing transformation and percentiles are also presented.
Author (USGRDR)

N69-22880# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
BINARY ANALYSIS. PART I: DEFINITIONS AND TREATMENT OF BINARY FUNCTIONS [ANALYSE BINAIRE. PREMIERE PARTIE: DEFINITIONS ET TRAITEMENT DES FONCTIONS BINAIRES]
René-Louis Vallee Sep. 1968 52 p in FRENCH; ENGLISH summary
(CEA-R-3534) Avail: CFSTI

The study of binary groups under their mathematical aspects constitutes the matter of binary analysis, the purpose of which consists in developing altogether simple, rigorous and practical methods needed by the technicians, the engineers and all those who may be mainly concerned by digital processing. This subject, fast extending if not determining, however tends actually to play a main part in nuclear electronics as well as in several other research areas.
Author (ESRO)

N69-22885# Wisconsin Univ., Madison. Dept. of Statistics.
THE VARIANCE OF SPECTRUM ESTIMATES
Henry R. Neave May 1968 82 p refs Sponsored by NSF and Sci. Res. Council of Gt. Brit.
(PB-180697; TR-158) Avail: CFSTI CSCL 12A

Since the asymptotic expression for the variance of estimates of the spectrum of a stationary time series was derived, it has often been used as an approximation to the variance of estimates using finite samples. In this paper, an exact expression for the variance is derived on the additional assumption that the time series is a normal process. This expression is then used to study estimates of four different spectra, using fairly small sample sizes, the Tukey and Parzen lag window generators, and three different truncation points in each case. Graphs of the standard deviation and also of the bias and root mean square error are given for the complete survey of one of the spectra investigated; tables are also included showing the behaviour of these quantities for all the four spectra.
Author (USGRDR)

N69-22886*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
A DIFFERENTIAL CALCULUS FOR MULTIFUNCTIONS
H. T. Banks and Marc Q. Jacobs [1969] 47 p refs
(Grant NGL-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-67-0693A)
(NASA-CR-100613) Avail: CFSTI CSCL 12A

A differential calculus for a reasonably generous class of multifunctions is developed, and some applications are pointed out. The derivative of a multifunctions is defined and Radstrom's embedding principle is applied to differentials of ordinary functions. Previous methods of developing a differential calculus for multifunctions are discussed and compared with the present work.
B.G.D

N69-22890# Wisconsin Univ., Madison. Dept. of Statistics.
ESTIMATION OF DERIVATIVES FROM DISCRETE DATA
William G. Hunter and Ralph D. Pollard Jan. 1968 47 p refs
(Grant NSF GK-1055)
(PB-180694; TR-137) Avail: CFSTI CSCL 12A

In engineering and scientific experimental work it is sometimes desired to estimate certain derivatives of a response. It is the purpose of this paper to investigate the derivative estimation problem and to develop appropriate statistical methods of experimental design and analysis for the case where an adequate model of the response is known. For this problem, the number of distinct derivatives is a more important consideration than the order of the derivatives. Each model has a characteristic design which is appropriate when the number of distinct derivatives to be estimated is equal to the number of parameters in the model. A characteristic design is appropriate for any set containing this number of distinct derivatives.
Author (USGRDR)

N69-22967*# Florida State Univ., Tallahassee. Dept. of Statistics.
A COMPARISON OF TWO MODEL-DISCRIMINATION CRITERIA
Duane Meeter, Walter Pirie, and William Blot 28 Oct. 1968 23 p refs
(Grant NGR-10-004-029)
(NASA-CR-100638; FSU-M146; TR-16) Avail: CFSTI CSCL 12A

Within the last few years there was increased research involving a generalization of sequential analysis problems in which the experimenter is allowed to design his experiment sequentially. Two different approaches to this sequential design of experiments or model discrimination problem were made by Chernoff and by Box and Hill. This paper compares the two approaches through examples. Some minor modifications of Chernoff's procedures are shown to lead to improved results.
Author

N69-22973*# McDonnell Douglas Astronautics Co., Santa Monica, Calif.
DEVELOPMENT OF CONSTRUCTIVE EXISTENCE THEOREMS IN OPTIMAL CONTROL THEORY Final Report
T. Guinn Oct. 1968 31 p refs
(Contract NAS7-586)
(NASA-CR-100585; DAC-63206) Avail: CFSTI CSCL 12A

These theorems for optimal control problems were investigated with the expectation that the results obtained would shed light on some of the inherent difficulties encountered in computation. A constructive existence theorem was obtained for an elementary control problem; however, conditions on the problem which assure that the underlying hypothesis is satisfied are not readily obtainable. Two related results were obtained which are of interest in their own right. Several results of a topological nature are presented which relate to approximations of functions. These results are utilized to study sequences of functions for solving approximate problems. An algorithm is developed which is expected to be useful in speeding up the convergence of gradient computational methods. The algorithm depends upon replacing the original problem by a new problem which is easier to solve.
Author

N69-22988*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GENERALIZED AVERAGING METHOD FOR LINEAR DIFFERENTIAL EQUATIONS WITH ALMOST PERIODIC COEFFICIENTS
Thomas J. Coakley Washington Apr. 1969 17 p refs
(NASA-TN-D-5167) Avail: CFSTI CSCL 12A

A new method for analyzing linear differential equations with almost periodic coefficients is described and discussed. The method is essentially a generalization of the classical Floquet theory developed for linear periodic systems. By use of the method, it is shown that an almost periodic system with rapidly varying coefficients can always be reduced or transformed to a corresponding system with either constant or slowly varying coefficients. An example is discussed which illustrates the method and indicates how the reduced system is frequently more easily analyzed than the original system.
Author

N69-23260# Rome Univ. (Italy).
REGULAR REPRESENTATION OF THE GROUP SU(3): EIGENFUNCTIONS AND EIGENVALUES OF THE BELTRAMI-LAPLACE OPERATOR DEFINED ON THE 4-DIMENSIONAL MANIFOLD IN THE EUCLIDEAN SPACE R_8
R. S. Liotta and L. Triolo 22 Jul. 1968 8 p ref *Its* Note No. 181
(NP-17687) Avail: AEC Depositary Libraries

The subspace of R_8 (octet space) invariant under the transformations of the regular representation of SU(3) is defined. The Beltrami-Laplace operator in this subspace is given and the properties of its eigenfunctions are found.
NSA

N69-23275# Bettis Atomic Power Lab., Pittsburgh, Pa.
DEVELOPING FLEXIBILITY MATRICES USING CTAC RULE
J. L. Bitner Oct. 1968 32 p refs
(Contract At(11-1)-Gen-14)
(WAPD-TM-749) Avail: CFSTI

Four examples illustrating a technique for evaluating elemental flexibility matrices, connection matrices, and total flexibility matrices are presented. A systematic matrix manipulation procedure called the CTAC rule is used to calculate the total flexibility matrix from the elemental flexibility and connection matrices. References to digital computer shock programs are made when applicable.
Author (NSA)

N69-23277# Los Alamos Scientific Lab., N. Mex.
VEBLEN-WEDDERBURN SYSTEMS
C. J. Everett. 20 Dec. 1968. 8 p. refs
(Contract W-7405-ENG-36)
(LA-3996) Avail: CFSTI

It is shown that Veblen–Wedderburn systems of order $N = p^n$, not division rings, exist for every $p \geq 2$, $n \geq 2$, for p an odd prime, and for $p = 2$, n composite. The proof suggests a matrix algorithm for constructing all V–W systems. The method is carried through for $p = 3$, $n = 2$ and reveals 5 such nonisomorphic systems. Some orienting remarks of an expository nature are included as an introduction to these structures and to their relation to the combinatorial configurations known as finite planes.
Author

N69-23299# Hungarian Academy of Sciences, Budapest. Central Research Inst. for Physics.
LITTLE GROUPS, ANALYTICITY AND FAMILIES OF REGGE TRAJECTORIES (AN ELEMENTARY APPROACH)
G. Domokos. 1968. 22 p. refs. Presented at Nobel Symp. 8, Aspenaes, Swed.
(KFKI-13/1968) Avail: CFSTI

A brief review of some ideas which have contributed to recent developments of Regge pole theory is given. These developments lead to an increased understanding of the properties of composite particles and also resolve some difficulties. After a brief review of some aspects of the representation theory of the Poincaré group the group properties of composite states are studied, and it is shown how the difficulties of Regge pole theory can be traced to certain properties of their spin algebra. This immediately gives the means of solving the difficulties and also leads to some physical consequences of which a few are briefly mentioned. The underlying physical ideas are emphasized at the expense of mathematical rigor.
NSA

N69-23332# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE CONSTRUCTION OF A CONFORMAL MAPPING FOR A COMPLEX DOUBLY-CONNECTED DOMAIN
E. A. Kolchanova et al. [1968] 9 p. refs. Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 4, no. 4, 1968 p. 8-15
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A conformal transformation was constructed of a complex, symmetric, doubly-connected domain with a high change gradient in the radius vector of the inner contour. The problem was solved by using an experimental-analytical technique. In addition, a method of improving the convergence of the iteration process is examined, and a description is given of practical representation of the calculations in tabular form.
A.C.R.

N69-23340*# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
CHANCE OF ALL SUCCESS FOR INDEPENDENT BINOMIAL EVENTS WITH LARGE SUCCESS PROBABILITIES
John E. Walsh. Sep. 1968. 8 p. ref
(Grant NGR-44-007-028; Contract N00014-68-A-0515)
(NASA-CR-100812; AD-679681; SMU-83-21; Rept-9) Avail: CFSTI CSCL 12/1

Consider reliability situations where all of n independent steps or operations must be satisfactory (successes) if the overall operation is to be satisfactory. The interest is in reliability levels that are at least moderately high. That is, the probability of obtaining successes for all steps and operations is at least moderately near unity. An approximate expression, also sharp upper and lower bounds, are developed for the probability of all successes. These results are applicable when $n(1 - p) < 1$, where p is the arithmetic average of the n probabilities of success for the steps and operations. The approximate expression is near the bounds when $n(1 - p) = or < .25$ and the relative error is less than one percent when $n(1 - p) = or < .17$; then, the true probability is at least .75 and at least .83, respectively. These results depend only on n and p. They are applicable for all $n >= or > 1$ and any set of success probabilities.
Author (TAB)

N69-23350# Papua and New Guinea Univ., Boroko
WHAT IS NEW IN MATHEMATICS? Inaugural Lecture
M. H. Mc Kay. 2 Jul. 1968. 16 p. refs
Avail: CFSTI

Starting with a historical review of the origins and progression of mathematics, this lecture outlines recent worldwide developments in all branches of mathematics. The impact of computerized calculations on mathematics is discussed as well as such recent developments as the theory of probability, number theory, geometric and algebraic topology, functional analysis, statistics, operations research, information theory, and the theory of games and strategy. The new trends toward abstraction, generality, and axiomatic approach are noted and discussed in terms of applications in teaching the New Mathematics. The teaching of mathematics in the Territory of Papua and New Guinea is briefly discussed in the context of the overall review.
K.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-21993# Atomic Energy Commission Research Establishment, Riso (Denmark).
THE MICROMETEOROLOGY OF THE TURBULENT FLOW FIELD IN THE ATMOSPHERIC SURFACE BOUNDARY LAYER
Niels E. Busch, John A. Frizzola (Brookhaven Natl. Lab.), and Irving A. Singer (Brookhaven Natl. Lab.) 1968. 52 p. refs. Its Acta Polytech. Scand., Phys. Nucl. Ser. No. 59
(PB-180792; APS-PH-59) Avail: CFSTI CSCL 04B

A recent analysis of spectral data taken under thermally neutral and unstable conditions is presented and compared with other analyses. The major conclusions are: (1) When plotted in similarity coordinates, the spectra of the longitudinal velocity components show no sign of dependence on thermal stability. Over a frequency range of particular interest in the field of structural engineering the spectra follow the $-5/3$ power law. (2) Within the accuracy of measurement, the spectra of the vertical velocity component obey similarity theory for moderate thermal instability. (3) The spectra of the lateral wind component are by far the most sensitive to changes in thermal stability and seem not to agree with similarity theories.
Author (USGRDR)

N69-22003# Arizona Univ., Tucson. Inst. of Atmospheric Physics.
DETECTION OF HAIL BY MEANS OF DOPPLER RADAR
Louis J. Battan and John S. Theiss. 1 May 1968. 27 p. refs
(Grants NSF GP-8539; NSF GA-1431)
(PB-180803; SR-24) Avail: CFSTI CSCL 04B

The doppler spectrum obtained by means of a vertically-pointing X-band pulsed doppler radar may yield information on the size distribution of hail in the free atsmophere. It is concluded that the quantity lambda in the size distribution curve for hail, N = N sub o to the minus lambda D power, is sometimes more than twice the values 2.27 or 2.93/cm proposed by earlier investigators. It is also shown that when both rain and hail are present the variance of the doppler spectrum may exceed 20 sq m/sq sec. Author (USGRDR)

N69-22116# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DAY-TO-DAY TEMPERATURE VARIABILITY IN THE STRATOSPHERE IN JANUARY AND JULY

G. G. Olintseva-Nebrat and L. A. Uranova Jun. 1968 12 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozon (Moscow), no. 152, 1966 p 68–72

(AD-681602; FTD-MT-24-185-68) Avail: CFSTI CSCL 4/2

The article deals with the distribution of day-to-day variability of air temperature in January and July at isobaric surface 100-10 mb above the northern half of the western hemisphere during the 1959-1962 period. Author (TAB)

N69-22163 Texas A&M Univ., College Station.

ON THE FEASIBILITY OF PRECISELY MEASURING THE PROPERTIES OF A PRECIPITATING CLOUD WITH A WEATHER RADAR

Robert Clayton Runnels (Ph.D. Thesis) 1968 133 p

Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-11477

A schematic cloud is proposed as a model for interpreting the interaction of the radar energy with the cloud. Point values of the liquid-water concentration are estimated from measurements of the received power. The measurements were made under conditions which minimized errors arising from attenuation of the radar signal and a radar beam which is not completely filled with raindrops. An improved continuity equation for liquid-water concentration is developed. The vertical speeds at the core of convective clouds are related to the spatial and temporal variations of the liquid-water content by means of this equation. The equation accounts for the downward development of a radar echo at speeds faster than the fall speed of raindrops. This echo development is caused by the coalescence mechanism. An error analysis indicated that the percentage error of the measurements of the liquid-water concentration may be as much as 102.4%. To check the estimated magnitudes of the experimental errors a case study was performed. Possible methods for reducing the experimental errors are considered. Dissert. Abstr.

N69-22300# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

THE MUTUAL VARIATION OF WIND, SHEAR AND BAROCLINICITY IN THE CUMULUS CONVECTIVE ATMOSPHERE OF THE HURRICANE

William M. Gray Oct. 1968 75 p refs *Its* Paper-104

(Grant NSF GF-177)

(PB-180729) Avail: CFSTI CSCL 04B

Observational information and calculations on the radial distribution of wind speed, vertical shear, and baroclinicity along 102 flight legs into hurricanes are presented. Observed baroclinicity in the lower half of the troposphere is shown to be two to three times larger than cylindrical thermal wind balance would require. This imbalance is explained as a consequence of vertical momentum transfer by the cumulus up- and downdrafts. These transfers produce significant horizontal accelerations through the correlation of vertical and horizontal wind components within the cumulus. A steady state imbalance of wind and pressure acceleration is hypothesized to be continually present at the inner radii of the hurricane. Author (USGRDR)

N69-22317# Air Weather Service, Scott AFB, Ill.

WEATHER. LOCAL WEATHER ANALYSIS PROGRAM

Jan. 1969 58 p Supersedes AWSM-105-22, 1 Oct. 1964 and AWSM-105-22A

(AD-681490; AWSM-105-22, AWSM-105-22A) Avail: CFSTI CSCL 4/2

The manual provides basic guidance for plotting, analyzing, and processing meteorological charts and diagrams. It is directed to those personnel who supervise detachment forecasting and observing functions. Author (TAB)

N69-22327# Weather Bureau, Sterling, Va. Test and Evaluation Lab.

THE AMOS 5 OBSERVER AID TEST, PART 1 Final Report

Elbert W. Atkins and Walter E. Hoehne Oct. 1968 20 p

(PB-180547; WBTM-T/EL-6-Pt-1) Avail: CFSTI CSCL 04B

The workload of the weather observer at airport stations increases during marginal weather. Non-routine duties increase and at the same time a closer monitoring of the weather is needed. This leads to the desirability for automation of surface weather observations. The Automatic Meteorological Observing System (AMOS 5) is one approach toward providing such automation. The purpose of the AMOS 5 Observer Aid Test was to determine how much AMOS 5 could help the observer. The AMOS 5 was programmed to acquire, process, display, and report surface weather data. The AMOS 5 was also programmed to indicate significant changes in the weather. Author (USGRDR)

N69-22384# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENT OF AUTOMATIC COMPILATION OF CLOUDINESS CHARTS BY ELECTRON COMPUTER SETUN DATA OF METEOROLOGICAL SATELLITES

N. M. Potievskii and N. I. Rumyantsev May 1968 10 p Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), no. 152, 1966 p 25–28

(AD-681591; FTD-HT-23-28-68) Avail: CFSTI CSCL 04/2

Problems involving the machine compilation of cloud-cover maps using a Setun computer and weather satellite data are examined. The Setun computer uses a ternary system of numbers and commands with input on ordinary punched telegraph tape. For compiling weather maps the Setun is mated to an EUM-48 output printer with a 45 cm-wide paper carriage and alphanumeric text. Using manual decoding and transcribing of satellite data and an elementary program, a method was developed whereby cloud-cover information was printed out in the form of letters indicating the type of clouds. Besides the map itself, a legend (octant, latitude, and longitude) is printed every 10 lines. Processing and printing take 15 minutes for a 60-line map with legend. One of the principal problems discussed in the article is automatic conversion of punched-tape satellite data into the computers ternary code. TAB

N69-22484# Weather Bureau, Silver Spring, Md. Equipment Development Lab.

A VISCOUS DAMPED WIND VANE

D. T. Acheson and H. H. Crouser Oct. 1968 26 p refs

(PB-180551; WBTM-EDL-5) Avail: CFSTI CSCL 04B

To provide an average wind direction, a viscous damper is inserted between the vane shaft and the shaft position transducer. Following a mechanical and electrical description of the system below, an analysis of the dynamic behavior of the system is given and experimental results presented. The motivation for designing and constructing the viscous damped wind vane is two-fold. Author (USGRDR)

N69-22535# Secretariat General a l'Aviation Civile, Paris (France). Section de Meteorologie Maritime.

WIND CHARTS FOR FRENCH COASTAL TOWNS ALONG THE NORTH SEA AND ATLANTIC OCEAN [LE VENT SUR LES COTES DE LA FRANCE METROPOLITAINE: MER-DU-NORD—MANCHE—ATLANTIQUE]

J. Darchen and A. de Block Dec. 1968 163 p refs In FRENCH *Its* Monographies de la Meteorol. Natl., no. 62, Fascicule 1
Avail: CFSTI

Semaphores are presented for wind speed and direction for French coastal towns along the Atlantic Ocean and North Sea. Transl. by B.P.

N69-22536# Secretariat General a l'Aviation Civile, Paris (France). Section de Meteorologie Maritime.

WIND CHARTS FOR FRENCH MEDITERRANEAN COASTAL TOWNS [LE VENT SUR LES COTES DE LA FRANCE METROPOLITAINE: MEDITERRANEE]

J. Darchen and A. de Block Dec. 1968 98 p refs In FRENCH *Its* Monographies de la Meteorol. Natl., No. 62, Fascicule 2
Avail: CFSTI

Monthly wind charts are depicted for seven French coastal towns along the Mediterranean. The data were collected at certain synoptic hours during the 1951 to 1960 period and consist of the monthly frequency of winds of certain speeds as a function of direction. Transl. by B.P.

N69-22570*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.

EXAMETNET DATA REPORT SERIES: ANNUAL REPORT, 1967

Washington 1969 188 p refs Prepared by Texas Univ., Shellenger Research Labs., El Paso
(NASA-SP-176) Avail: CFSTI CSCL 04B

Exametnet meteorological rocket launchings and data dissemination are conducted synoptically from launch sites at Chamical, Argentina; Natal, Brazil; and Wallops Island, Virginia, U.S.A. The reduced data from the launchings for each quarter are checked, further reduced, compiled, and published in the Exametnet Data Report Series. These network data reports, after being reviewed and edited by all participants of the Exametnet, are then compiled into the annual publication for broad dissemination. This annual publication contains, for the year 1967, the meteorological rocket observational data acquired by each participant. Appendixes concerning related activities of the Exametnet are also included in the annual reports. The appendixes for this report describe the data and some of the technical and scientific activities of Exametnet participants and, in addition, list all Exametnet and related publications. Author

N69-22590# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany). Dept. of Telecommunications.

THEORETICAL ANALYSIS MEDIUM-DEPENDENT FLUCTUATIONS WITH TROPOSPHERIC SCATTER LINKS, AND COMPARISON WITH NEW EXPERIMENTAL DATA, INCLUDING SIDE-SCATTER CHARACTERISTICS

H. J. Albrecht *In* AGARD Scatter Propagation of Radio Waves, Pt. 1 Aug. 1968 12 p refs (See N69-22576 11-07)
Avail: CFSTI

A theoretical analysis of parameters affecting the strengths of signal attenuation caused by certain weather situations yields values corresponding to the Kolmogorov–Obukhov "two-thirds-law", generally accepted for the interdependence of turbulence scale and the mean square of velocity differences. The resultant expression contains the general temperature structure and permits an explanation of seasonal effects found experimentally. The good agreement between theoretical and experimental values is illustrated by new experimental data, including additional scatter links. Aspects of forecasting weather-dependent conditions interfering with a normal behavior of tropospheric scatter links are mentioned. Author

N69-22636*# Boeing Co., Seattle, Wash.

AN ANALYSIS OF THE JIMSPHERE ASCENT RATE WITH A DISCUSSION OF VERTICAL MOTIONS IN THE WINDS ALOFT

R. S. Wheeler Apr. 1969 58 p refs
(Contract NAS8-5608)
(NASA-CR-61276; D5-15567) Avail: CFSTI CSCL 04B

Perturbations of relatively large wavelengths are observed in the ascent rates of Jimsphere balloons. These are shown to be indications of vertical motions in the atmosphere. High frequency noise introduced by the FPS-16 Radar tracking is also observed in the data but this can be eliminated effectively by means of low pass filtering. To evaluate perturbations of significant wavelength a mean rate of rise of the Jimsphere is determined from filtered individual rise rate profiles which are then compared with the mean rise rate to evaluate the perturbations. A discussion of probable relationships of these perturbations with features on the profiles of the horizontal winds is also presented. It is concluded that the FPS-16 Radar/Jimsphere Wind Measuring System detects the larger vertical motions of the atmosphere. Author

N69-22776# France. Ministere de l'Air, Paris.

CONTRIBUTION TO THE STUDY OF CLEAR AIR TURBULENCE [CONTRIBUTION A L'ETUDE DE LA TURBULENCE EN AIR CLAIR]

R. Pedeau Dec. 1968 46 p refs In FRENCH Its Monograph No. 68
Avail: CFSTI

Statistical analyses were performed on collected turbulence flight data above the European and African Mediterranean region, north of the 15th parallel. Connections were made between the distribution of clear air turbulence at high altitude, both geographically and as a function of flight level. Correlations were found to exist between certain meteorological factors and turbulence and between certain configurations of synoptic fields and turbulent zones. The clear air turbulence regions in the atmosphere are defined, tabulated, and charted. Transl. by B.P.

N69-22848# Secretariat General a l'Aviation Civile, Paris (France).

VARIATION OF WINDS WITH ALTITUDE AS A FUNCTION OF TIME [VARIATION DU VENT EN ALTITUDE DANS LE TEMPS]

J. Dettwiller (SMM/Etudes Spec., Paris) Dec. 1968 33 p refs In FRENCH *Its* Monographies de la Meteorol. Natl. No. 63
Avail: CFSTI

The general persistence method for expressing wind variation as a function of past time, errors affecting wind measurements, condensed results deduced from various data, and several examples of practical application are treated. It is noted that the precision sought by some users cannot be attained. An annex is included

on wind variation as a function of time in proximity to the sun, examined from a series of 350 soundings in October, 1967. The results permit an estimation of wind measurement errors provided by optical sounding with a theodolite. Transl. by P.A.B.

N69-22958# Geophysics Corp. of America, Bedford, Mass. Technology Div.
METEOROLOGICAL INFERENCES FROM RADIANCE MEASUREMENTS, PHASES A AND B Final Report
Frederick B. House, Richard Harrison, Edwin T. Florance, and Jean I. F. King Sep. 1968 131 p refs
(Contract CWB-11317)
(PB-180296; GCA-TR-68-18-G) Avail: CFSTI CSCL 04B

An improved transmittance model is developed and used to calculate radiances from the Palestine, Texas temperature profile. Synthetic data are used to infer three-ramp temperature profiles with the nonlinear inversion method. A technique termed the direct inversion method is presented which approaches the temperature inference problem by employing a simple linear inversion in the cloud-free stratosphere and by applying directly the radiative transfer equation with gray clouds in the troposphere. A solution is obtained in the troposphere by minimizing the mean square error between computed and observed radiances for a large number of trial solutions. Author (USGRDR)

N69-22959# Weather Bureau, Garden City, N. Y. Eastern Region Headquarters.
A STUDY OF THE AREAL DISTRIBUTION OF RADAR DETECTED PRECIPITATION AT CHARLESTON, S. C.
S. K. Parrish and M. A. Lopez Oct. 1968 21 p refs
(PB-180324; WBTM-ER-31) Avail: CFSTI CSCL 04B

The paper presents a series of charts showing the areal distribution of radar detected precipitation within 125 n.mi. of the Weather Bureau Airport Station at Charleston, South Carolina, for each month during the period June 1966 through May 1967. In addition, the data are broken down into two twelve-hour time periods, 1100E–2200E and 2300E–1000E, to illustrate the shift in diurnal frequency. The seasonal variation in distribution and precipitation types are also evident. Author (USGRDR)

N69-22964# Weather Bureau, Salt Lake City, Utah. Western Region.
JOINT ESSA/FAA ARTC RADAR WEATHER SURVEILLANCE PROGRAM
Herbert P. Benner and Devon B. Smith Dec. 1968 39 p refs
(AD-681857; WBTM-WR-35) Avail: Issuing Activity CSCL 4/2

A description is given of the ARTC weather radar program. The successful use of ARTC radar exemplifies what can be achieved by exploiting the limited weather detection capabilities of ARTC radar. Weather Bureau Forecast Offices report that they are providing better weather services to aviation and the general public because of the availability of these radar data. The future use of ARTC radars for weather surveillance will depend largely on the establishment of a Weather Radar network in the West and on the future reconfiguration of the FAAs National Air Space System. In the interim, the ESSA/FAA Joint ARTC Weather Radar program will continue to provide essential radar data to the forecaster and stand as an excellent example of cooperation between two Government agencies in providing public services. Author (TAB)

N69-23002# Chicago Univ., Ill. Dept. of Geophysical Sciences.
A MODEL OF TYPHOONS WITH OUTFLOW AND SUBSIDENCE LAYERS. SATELLITE AND MESOMETEOROLOGY RESEARCH PROJECT
Tatsuo Izawa Jan. 1969 30 p refs
(Grant Cwb-E-22-45-68-(G))
(SMRP-RP-76) Avail: Issuing Activity

Pictures of typhoons and hurricanes taken from NIMBUS and ESSA satellites are given. A modified model of typhoons accompanied by inner and outer rainbands and a subsidence layer is proposed. The wind shear between the outflow and the middle layers and subsidence layer was computed and compared with the general pattern of wide longitudinal bands of cirrus clouds. B.G.D.

N69-23108# Weather Bureau, Sterling, Va. Test and Evaluation Lab.
TEST AND EVALUATION OF THE FISCHER AND PORTER PRECIPITATION GAGE Final Report
Walter E. Hoehne Aug. 1968 33 p
(PB-180290; WBTM-T/EL-7) Avail: CFSTI CSCL 04B

The results of the Fischer and Porter precipitation gage-recorder test and evaluation at the Sterling research and development center are given. Author (USGRDR)

N69-23109# National Severe Storms Lab., Norman, Okla. ESSA Research Labs.
OBJECTIVE DETECTION AND CORRECTION OF ERRORS IN RADIOSONDE DATA
Rex L. Inman Jun. 1968 56 p refs
(PB-180284; ERLTM-NSSL-40) Avail: CFSTI CSCL 04B

Procedures employed at the national severe storm forecast center for detecting and correcting gross errors in radiosonde data are described. The results indicate that about 75 percent of the errors and/or deficiencies that are found are normally corrected. In most of the remaining cases, nothing can be done because of too much missing data; this problem usually is caused by errors in the coding of the information. Author (USGRDR)

N69-23110# Travelers Research Center, Inc., Hartford, Conn.
HURRICANE PREDICTION USING SIMULATED NWP PREDICTORS
Oct. 1968 13 p refs Sponsored by ESSA
(PB-180673; TRC-7401-329) Avail: CFSTI CSCL 04B

The incorporation of numerical prognoses in statistical models to predict hurricane motion is discussed. The method utilized was to simulate the numerical prognoses with analyses in the historical data sample. However, the use of these perfect prognoses led to prediction equations that overweighted prognostic predictors. Using operational national weather prediction variables as predictors in lieu of perfect prognoses has undesirable features. A method to overcome some of the difficulties is to adjust the covariance matrix derived from the historical sample containing perfect prognoses prior to performing the screening regression analysis. These adjustments are functions of statistical characteristics of the error fields of the dynamical prognoses as determined from the available sample of operational prognoses. Author (USGRDR)

N69-23114# Weather Bureau, Salt Lake City, Utah. Western Region.
OBJECTIVE FORECASTING
Philip Williams, Jr. Aug. 1968 44 p refs
(PB-180291; WBTM-WR-33) Avail: CFSTI CSCL 04B

The purpose of this technical memorandum is to acquaint field forecasters with the advantages and limitations of objective

forecast aids and procedures to be employed in developing on-station aids. Such aids are also referred to as conditional climatological studies. Development of objective forecast aids is encouraged as a means of adding accuracy to short-range forecasts. Objective aids help bridge the gap between NMC macroscale circulation forecasts and the prediction of small-scale weather systems, because local effects such as terrain influences, etc., are automatically 'built' into the aid. Author (USGRDR)

N69-23115# St. Louis Univ., Mo. Dept. of Geophysics.
THE SYNOPTICS, DYNAMICS AND ENERGETICS OF THE TEMPORAL USING SATELLITE RADIATION DATA (IN ADDITION TO CONVENTIONAL OBSERVATIONS). SECOND YEAR'S REPORT NO. 1: ACTIVATION OF THE INTERTROPICAL TROUGH ZONE WEST OF CENTRAL AMERICA BY INTERHEMISPHERICAL INFLUENCES
Albert J. Pallmann Jan. 1968 35 p refs
(Grant CWB-WBG-89)
(PB-180286) Avail: CFSTI CSCL 04B

During the time period of 4–6 November 1963, a tropical storm developed within the Intertropical Trough Zone just west of Costa Rica, Central America. The storm is locally known as the 'temporal'. In the present report, no detail about the storm structure is offered. The author would rather dwell on the question of how the Intertropical Trough Zone west of Panama and Costa Rica became active and generated the 'temporal'. However, the sequence of synoptic surface charts is presented to facilitate a gradual familiarization with the case. Author (USGRDR)

N69-23116# St. Louis Univ., Mo. Dept. of Geophysics.
THE SYNOPTICS, DYNAMICS AND ENERGETICS OF THE TEMPORAL USING SATELLITE RADIATION DATA. THE TEMPORAL OF JUNE 1966 AS EVIDENCED BY THE NIMBUS 2 HRIR, MRIR, AVCS, AND MARITIME OBSERVATIONS. SECOND YEAR'S REPORT NO. 2
Albert J. Pallmann Aug. 1968 109 p refs
(Grant CWB-WBG-89)
(PB-180287) Avail: CFSTI CSCL 04B

The report contains Nimbus II satellite photographic and radiation data which has been utilized for the first time, after an appropriate methodology was developed. In relation to various modes of Nimbus II satellite data, a critical evaluation of the limits of accuracy for those as well as for some aerological data was carried out. Some of the conventional data were processed and reduced by means of power spectral density analysis and Fourier methods in order to achieve objective smoothing. Again this year the concept of interlocking both types of analyses, namely the satellite data and the conventional observation analyses, has been applied. Author (USGRDR)

N69-23117# Stanford Research Inst., Menlo Park, Calif.
SATELLITE-VIEWED CLOUD COVER AS A DESCRIPTOR OF ATMOSPHERIC PROPERTIES Final Report
R. H. Blackmer, Jr., P. A. Davis, and S. M. Serebreny Jun. 1968 56 p refs
(Contract E-126-67(N))
(PB-180288) Avail: CFSTI CSCL 04B

The study explored the feasibility of using satellite-viewed cloud cover as a descriptor of selected atmospheric properties. Satellite-viewed cloud cover in the vicinity of Ocean Station Papa was classified into nine categories according to amount, type, height, and position relative to bands. The selected properties described in terms of departures from the seasonal normals were the vertical temperature profile, vertical moisture profile, 500-mb height and 1000- to 500-mb thickness. Studies were also made of relationships between four cloud cover categories and gradients of 500-mb thickness. Studies were also made of relationships between four cloud cover categories and gradients of 500-mb height, 500-mb temperature and surface pressure. The gradients were computed for the triangle formed by Ocean Station Papa, and two nearby Radar Picket Stations. Author (USGRDR)

N69-23118# Stanford Research Inst., Menlo Park, Calif.
CLOUD PHOTO INTERPRETATIONS OF SELECTED CYCLONES AND THUNDERSTORMS Final Report
J. H. S. Keaiohe, S. M. Serebreny, and M. I. Smith Sep. 1968 70 p refs
(Contract E-34-68(N))
(PB-180289) Avail: CFSTI CSCL 04B

Two weather patterns, one in January 1967 and the other in June 1967, were studied. Both show stagnant weather conditions that produced local heavy precipitation. The first, a west coast cyclone, dominated the weather pattern and resulted in an all-time 24-hour precipitation record at Seattle and San Francisco. The second was associated with extensive thunderstorm activity in the mountain states during six days in June. They were described in terms of satellite pictures, nearly concurrent observations of precipitation by radar, and other conventional surface and upper air charts. Evidence was sought in the satellite-viewed cloud cover that would enable an accurate evaluation of the wind field and an early apprehension of stagnation and ensuing excessive rainfall. Author (USGRDR)

N69-23178# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 92, NO. 10: RESULTS OF THE SYNOPTIC SERVICE DURING 1968. DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb), BERLIN READINGS, AND BRIEF SCIENTIFIC ARTICLES [METEOROLOGISCHE ABHANDLUNGEN, BAND CXII, HEFT 10: ERGEBNISSE DES SYNOPTISCHEN DIENSTES IM JAHRE 1968, TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb), BERLINER MESSWERTE UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Richard Scherhag et al Oct. 1968 319 p refs In GERMAN
Avail: CFSTI

In addition to the daily weather charts and daily atmospheric and meteorological readings for Berlin during October 1968, this report contains the following Berlin summaries for that month: (1) climatological averages; (2) temperature and precipitation data; (3) atmospheric radioactivity; (4) a climatological review; and (5) an analysis of a small tornado. The brief articles cover cloud formation over Florida during the summer, meteorological considerations regarding the location of nuclear power plants, jet streams in satellite photographs, statistical analysis of a foehn, and data transmission via telephone cables. Transl. by K.W.

N69-23179# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 92, NO. 9: RESULTS OF THE SYNOPTIC SERVICE DURING 1968. DAILY WEATHER MAPS (GROUND, 500 mb, 300 mb), BERLIN READINGS, AND BRIEF SCIENTIFIC ARTICLES [METEOROLOGISCHE ABHANDLUNGEN, BAND XCII, HEFT 9: ERGEBNISSE DER SYNOPTISCHEN DIENSTES IM JAHRE 1968, TAEGLICHE WETTERKARTEN (BODEN, 500 mb, 300 mb), BERLINER MESSWERTE UND KLEINERE WISSENSCHAFTLICHE AUFSAETZE]
Richard Scherhag et al Sep. 1968 295 p refs In GERMAN
Avail: CFSTI

In addition to the daily weather charts and daily atmospheric and meteorological readings for Berlin during September 1968, this report contains the following Berlin summaries for that month: (1) climatological averages; (2) temperature and precipitation data; (3) atmospheric radioactivity; and (4) a climatological review. The brief articles cover the world weather situation and weather forecasts for September 1968, cloud seeding in the Kings River area of California, weather types in the French Antilles, and worldwide climate fluctuations. Transl. by K.W.

N69-23262# Oklahoma Univ., Norman. Dept. of Meteorology.
BEHAVIOR OF DISCRETE CONVECTIVE ELEMENTS IN A ROTATING FLUID
E. W. Friday, Jr. Mar. 1969 142 p refs
(Grant NSF-GA-1328)
(Rept-12) Avail: Issuing Activity

During the past few years, time lapse films of radar observations of severe storms have demonstrated that many of the severe storms are rotating about some vertical axis. Such a rotational motion could provide an angular momentum source for the formation of a tornado vortex, but a more basic question should be answered relative to the storm's angular velocity. This question concerns the behavior of a convective element which is growing in the presence of a rotating field. In essence, does the presence of a rotational field enhance or suppress the convection? A look at the essence of convective motion is indicated. Two forms of these individual convective elements considered in the past are mathematical idealizations of a real situation, and yet still represent the physical essence of the real situation. The first, called a thermal, is idealized as that convective element which has its origin as an instantaneous point source of buoyancy. Author

N69-23282# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 87, NO. 3: THE ACCURACY OF ATMOSPHERIC PRESSURE MEASUREMENTS, ESPECIALLY WITH THE BAROLUX [METEOROLOGISCHE ABHANDLUNGEN. BAND 87, HEFT 3: DIE GENAUIGKEIT DER LUFTBRUCKMESSUNG, INBESONDERE MIT DEM BAROLUXGERAET]
Matthias Eckardt 1968 63 p refs In GERMAN; ENGLISH summary
Avail: CFSTI

The absolute accuracy of atmospheric pressure measurements is discussed for different types of barometers, especially for the precision aneroid barometer with optical magnification, the Barolux. The pressure can be read by this instrument to ± 0.02 mb; it is nearly independent of the position used; little deviations can be corrected. Under the normal range of room temperature the temperature compensation of this instrument is perfect, but rapid and extended changes in temperature are not completely compensated. The drift is shown by means of many barometer comparisons which have been made with this instrument since 1956. The factors influencing all atmospheric pressure measurements are mentioned. The determination of station pressure is sometimes influenced by strong and gusty winds, but effects of temperature changes also cause some errors. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N69-22395# Weapons Research Establishment, Salisbury (Australia).
DESIGN OF THE ROTATIONAL KINETIC ENERGY DISSIPATION SYSTEM FOR THE WRE SATELLITE WRESAT 1
D. J. Baines Sep. 1968 55 p refs
(WRE-TN-HSA-134) Avail: CFSTI

The fluid loop energy dissipator fitted to the Weapons Research Establishment satellite, WRESAT 1, to ensure adequately fast attainment of the stable spin condition is described. Two theories giving the rate of dissipation of energy in terms of geometrical properties of the loop and physical properties of the fluid are presented. One is a simple analysis based on consideration of the mean cross-sectional flow within the tube, whereas the second is derived from the equation of laminar pipe flow and takes account of the variation in fluid velocity in the plane of the cross-section. Theoretical predictions of dissipator performance are compared with experimental measurements made with the dissipator in free oscillation as a compound pendulum, and with telemetry measurements from WRESAT 1 during its first orbit. Author (ESRO)

N69-22410# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
PROCEDURE OF PHASE DELAY COMPENSATION FOR INCREASE OF ACCURACY OF DOPPLER NAVIGATION SYSTEMS WITH WIDE-APERTURE ANTENNAS [LAUFZEITKOMPENSATIONSVERFAHREN ZUR ERHOEHUNG DER GENAUIGKEIT VON DOPPLER-GROEBASISSYSTEMEN]
F. Fischer Jan. 1969 85 p refs In GERMAN; ENGLISH summary
(DLR-FB-69-03) Avail: CFSTI

The exact compensation of phase delay distortions in direction finding and navigation systems is possible by periodic changes of the scanning direction and the synchronous channel commutation of the signal and reference voltages. This method has been realized in a new type of solid state Doppler direction finder by electronical scanning of the wide-aperture antenna and by a digital phase measurement. The equipment is described and the most important results of the tests are discussed. An accuracy of bearing of better than ±0.05° was achieved, which offers the suggestion to apply this method particularly, in the more topical Doppler-VOR beacon. Some sketches for this design are presented. Author

N69-22936*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMULATION STUDIES FOR PLANNING AN IN-FLIGHT EXPERIMENT TO DEFINE MANUAL GUIDANCE AND CONTROL TECHNIQUES FOR LARGE LAUNCH VEHICLES
De Lamar M. Watson, Gordon H. Hardy, and Glenn W. Stinnett Washington Apr. 1969 32 p refs
(NASA-TN-D-5150) Avail: CFSTI CSCL 17G

The simulator program described was undertaken to define an in-flight experiment to evaluate manual control system concepts for Saturn class launch vehicles. The techniques and manual control system configurations developed in earlier studies were adapted to the uprated Saturn I, which was the vehicle chosen for the experiment. Discussions of the vehicle and manual control system configuration, the handling qualities, and two manual guidance display schemes are presented. An assessment is made of the impact of the proposed experiment on mission reliability. Author

N69-22988*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NIGHT SKY BACKGROUND CONDITIONS AND LAUNCH WINDOWS FOR RESEARCH EXPERIMENTS

Jean C. Keating Washington Apr. 1969 32 p refs
(NASA-TM-X-1772) Avail: CFSTI CSCL 17G

Darkness of the night sky background is required by many research experiments during various portions of their flight. A method was originally developed for the Trailblazer series to define launch windows that coincide with periods during which the brightness of the night sky background results solely from the illumination produced by the myriad of stars. Since this same method has proved useful to many other experiments as well, a general description of the method and the computer program developed to determine such launch windows are discussed. For any location between latitudes 60°N and 60°S, such times of launch may be determined to an accuracy of 2 minutes. Author

N69-22996*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EVALUATION OF A PILOT DESCRIBING FUNCTION METHOD APPLIED TO THE MANUAL CONTROL ANALYSIS OF A LARGE FLEXIBLE BOOSTER
Dallas G. Denery and Brent Y. Creer Washington Apr. 1969 28 p refs
(NASA-TN-D-5149) Avail: CFSTI CSCL 17G

In the pilot describing function technique of manual control analysis, the pilot is represented by a linear describing function and a statistically described remnant. The remnant accounts for that part of the pilot output not linearly correlated with the input. The technique was pioneered in work on manual control of rigid vehicles and has resulted in a catalog of pilot describing functions and remnant data applicable to certain pilot tasks. In this report, the method is evaluated for use in analyzing the pilot control of a large flexible booster. There are two phases in the present investigation. In the first, the pilot describing function method is evaluated when applied to the analysis of pilot control of an uncompensated booster. A piloted flight simulator is used and the pilot describing function, remnant and performance opinion ratings are measured. In the second phase, the pilot describing function method is evaluated when used to define a compensation system for the flexible booster. Pilot opinion ratings measured for this compensating system, using a flight simulator, are compared with ratings estimated using the pilot describing function method. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-21884 New Mexico Univ., Albuquerque.
COMPUTATIONAL ASPECTS OF OPTIMAL CONTROL WITH APPLICATIONS TO A NUCLEAR ROCKET REACTOR
Harold J. Price (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-11663

Several methods for the numerical calculation of optimal controls are considered with a view toward the calculation of the optimal controls for startup of a nuclear rocket reactor. The nuclear rocket reactor is approximated by the classical one-lump, spacially-independent neutron kinetics equations coupled to a one-lump, heat transfer process. The thrust of the nuclear rocket reactor is obtained from the reaction force of hot hydrogen gas exhausting through a suitable nozzle. It is assumed that the controls for the nuclear rocket reactor are reactivity and hydrogen flow-rate. The optimization problem is defined by requiring that the amount of hydrogen consumed in transferring the reactor from a low power condition to a high power condition be minimal. Dissert. Abstr.

N69-22185# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
ULTRASONIC TEST SUPPORT FOR CONTAINER INTEGRITY ASSURANCE
R. W. Staffens 23 Sep. 1968 24 p Presented at AIME Nucl. Met. Symp., Oak Ridge, Tenn.
(Contract AT(45-1)-1830)
(BNWL-SA-2111; CONF-680929-1) Avail: CFSTI

Ultrasonic nondestructive testing techniques can be used to establish the container integrity of fueled isotope capsules. The ability of ultrasound to detect close fitting cracks, and to obtain complete inspection of the container volume, was found to supplement the information normally acquired through radiographic, dye penetrant, and metallographic analysis. The ultrasonic inspection of the raw material quality and establishment of basic ultrasonic techniques are discussed. Adequate weld parameter characterization and the subsequent assurance of weld testability on the fuel capsule are described. Radiographic and metallographic analyses are used extensively during the ultrasonic test development phase to verify the ultrasonic test results. The results must be standardized and calibrated. NSA

N69-22214# Kyoto Univ. (Japan). Research Reactor Inst.
A USEFUL GAMMA-RAY SOURCE OF POWDERED Ir-192 FOR RADIOGRAPHICAL UTILIZATION
Tadashi Tsujimoto, Teruie Sumino, and Kosuke Katsurayama [1968] 7 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-31) Avail: CFSTI

Radioactive materials for radiography should be small in volume and high in specific activity. Powdered radioactive isotope ^{192}Ir was produced by nuclear reactor irradiation for non-destructive testing. Experiments on the specific activities of gamma rays were performed for several geometries of cylindrical samples, with the same diameters and heights (1.5 to 5.0 mm long). The experimental results were one and one-half to three times as large as the calculated values which were evaluated on the assumption that the powdered iridium might be uniformly distributed in an arbitrary volume. The difference seems to be caused by the fact that the self-shielding effects of neutrons by the samples were smaller than the values used in the calculation, because the samples employed were composed of the particles with about 200 meshes. It may be seen that the gamma-ray source of the powdered iridium can be of practical use for the non-destructive testing. Author (NSA)

N69-22238*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REACTOR POWER FOR LUNAR EXPLORATION
Gordon R. Woodcock and James B. Brewer *In its* 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 139-156 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 18N

The study of the application of reactor power systems to manned lunar missions was instituted with the following principal objectives: (1) to evaluate the capabilities of the hardware and technology under development by the SNAP-8 and associated programs; (2) to identify and evaluate the major operational interfaces between a manned lunar surface mission and the reactor power systems and to determine the influence of each upon the other; (3) to determine desirable modifications to the SNAP-8 and other reactor power systems to enhance their applicability to manned lunar surface missions; and (4) to develop guidelines and design

criteria for ongoing reactor power technology development programs. Concepts were developed and evaluated for integration into the manned lunar mission of a SNAP-8 reactor, Rankine cycle system; a SNAP-8 reactor, thermoelectric system; and a SNAP-8 reactor, Brayton cycle system. The major emphasis was on the SNAP-8 reactor, Rankine cycle system. Author

N69-22260# Babcock and Wilcox Co., Lynchburg, Va. Power Generation Div.
FAST BREEDER REACTOR STATIC PHYSICS METHODS DEVELOPMENT AND ANALYSIS PROJECT Quarterly Technical Report, Jul.–Sep. 1968
J. A. Jacobsen, D. H. Roy, J. E. Stewart, and J. M. Tilford Nov. 1968 60 p refs
(Contract AT(30-1)-3867)
(BAW-3867-5; QTR-5) Avail: CFSTI

A description of the FARED computer program overlay structure is presented. Depletion calculations are included for 2000 and 8000 liter fast breeder reactor cores using three combinations of cross-section data. The generalized refueling scheme is described. NSA

N69-22262# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PLUTONIUM UTILIZATION PROGRAM Technical Activities Quarterly Report, Jun.–Aug. 1968
Nov. 1968 69 p refs
(Contract AT(45-1)-1830)
(BNWL-907) Avail: CFSTI

Americium isotopes' gamma dose rate measurements effect on high exposure plutonium oxide surface is discussed. Measurements of critical number of aluminum–plutonium fuel rods in water moderator and its effect on lattice pitch and boron concentration on fission products is also presented. Fission products were measured when released from plutonium oxide and uranium oxide. The plutonium recycle test reactor was used for fuel element testing, irradiation testing of plutonium and uranium oxides, and improvement in PNL. Fission gas pressure measurements were made. There was an analysis of failures from transient testing of uranium oxide pellet-type and vibrational compaction. Physics were measured for water moderated PuO_2 and UO_2 square lattice. NSA

N69-22331# Technische Hochschule, Karlsruhe (West Germany). Institut fuer Struktur der Materie.
ANALYTICAL METHOD TO CALCULATE THE SPACE DEPENDENT NEUTRON SPECTRUM IN A HETEROGENEOUS REACTOR CELL WITH ANY GIVEN MODERATOR
P. Kammerer Jul. 1968 55 p refs In GERMAN
(BMwF-FBK-68-32) Avail: CFSTI

Using diffusion theory with energy dependent diffusion coefficient and the generalized heavy gas model, an analytical solution is given for the space and energy dependent neutron flux. It is assumed, that the absorption follows the 1/v-law, or can be expanded in powers of 1/v. Spectra are calculated for cells of different moderators (H_2O, graphite, D_2O). They are compared with numerical results and calculations using the simple heavy gas model. It is seen that using the improved generalized heavy gas model instead of the simple heavy gas model gives a difference up to 20% even in the center of the fuel rod. Author (NSA)

N69-22338# Oak Ridge National Lab., Tenn. Office of Language Services.
EFFECTIVENESS OF BORON IN ACCELERATOR SHIELDS ON SCATTERED RADIATION
L. N. Zaitsev et al Jun. 1968 7 p refs Transl. into ENGLISH of Russian Rept. JINR-P16-3936
(ORNL-tr-2022; JINR-P16-3936) Avail: CFSTI

Data are presented from experimental studies on the addition of boron to ordinary concrete for two cases: (1) use of a boron containing covering with different boron contents on the shield face and (2) addition of boron, 15 kg/m^3, to the shield. NSA

N69-22345# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
THE CYRANO PROGRAM. 1: DESCRIPTION AND OPERATION OF AN IRRADIATION DEVICE CYRANO. 2: RESULTS OF THE CYRANO 1 AND 2 EXPERIMENTS; STUDY OF THE EL 4 FIRST-CORE RODS; MEASUREMENT OF THE THERMAL CONDUCTIVITY INTEGRAL UP TO 2300°C FOR URANIUM DIOXIDE SINTERED; EVOLUTION OF FISSION GASES AT CONSTANT POWER [PROGRAMME CYRANO. 1: DESCRIPTION ET EXPLOITATION D'UN DISPOSITIF D'IRRADIATION "CYRANO." 2: RESULTATS DES EXPERIENCES CYRANO 1 ET 2 (ETUDE DU CRAYON EL4 1ER JEU); MESURE DE L'INTEGRALE DE CONDUCTIBILITE THERMIQUE D'UO_2 FRITTE JUSQU'A 2300°C; EVOLUTION DES GAZ DE FISSION A PUISSANCE CONSTANTE]
Jean-Pierre Stora and Pierre Chenebault Sep. 1968 114 p refs In FRENCH
(CEA-R-3618; DM/1692) Avail: CFSTI

Two rods of the type in the EL 4 first charge were irradiated in Cyrano capsules which are suited for continuous measurement of the nuclear power evolved and equipped with thermocouples. The variations of the integral of conductivity of sintered 96% theoretical density UO_2 were measured to 2300°C; these variations are consistent with those previously measured out-of-pile. The released fission gases were recovered at different times during the irradiation. The kinetics of release of stable gases is such that the fraction of released gases is still widely increasing after 12 days of irradiation. Numerous observations were made on local concentrations of rare gases in the irradiated fuel. Author (NSA)

N69-22408# Los Alamos Scientific Lab., N. Mex.
SPACE ELECTRIC POWER R AND D PROGRAM PART 1 Quarterly Status Report, Period Ending 31 Oct. 1968
22 Nov. 1968 6 p
(Contract W-7405-ENG-6)
(LA-4039) Avail: CFSTI

Fluid pressure conditions which can occur with annular return heat pipes using cesium, mercury, potassium, or sodium as the working fluid are described, and calculated values are compared with experimental measurements. NSA

N69-22413# Minnesota Mining and Mfg. Co., St. Paul, Minn. Space and Defense Products.
SNAP 23A PROGRAM. PHASE 1: THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, 1 Apr.–30 Jun. 1968
30 Jun. 1968 89 p
(Contract AT(30-1)-3824)
(MMM3824-0023; QR-6) Avail: CFSTI

Approval of the Prototype Mockup Converter (PMC) design was received; fabrication and processing of PMC-1 was completed. Converter EMC-2 was placed back on long-term test after repairs were completed to the heat source assembly of the process and test station; and EMC-3 was placed on long-term test. The PMC contains several design changes with respect to the Experimental

Mockup Converter (EMC) design; they are: the thermoelectric couple configuration was optimized, the follower material was changed from aluminum hard-coated to beryllium oxide, and the interface dimensions were redefined which subsequently required additional measurement detail and variable data documentation. It is anticipated that the thermoelectric couple optimization will provide a converter efficiency greater than that which has been demonstrated previously in the EMC devices. Long-term testing of 10-couple modules 1 through 12 was continued, with statistical analysis made every 1000 hours on the data from modules 5 through 12. Author (NSA)

N69-22431# Oak Ridge National Lab., Tenn. Neutron Physics Div.

SHIELDING CALCULATIONS FOR A 200-MeV PROTON ACCELERATOR

R. G. Alsmiller, Jr., J. Barish, R. T. Boughner and W. W. Engle Dec. 1968 17 p refs

(Contract W-7405-ENG-26)

(ORNL-4336) Avail: CFSTI

The results of high energy neutron transport calculations carried out to aid in the design of the radiation shield for a 200-MeV proton accelerator are presented. Author (NSA)

N69-22441# Japan Atomic Energy Research Inst., Tokyo.

PROCEEDINGS OF THE 2nd SEMINAR ON PHYSICAL PROPERTIES OF FAST REACTOR FUELS

1969 63 p refs In JAPANESE; ENGLISH summary

(JAERI-1172) Avail: CFSTI

CONTENTS:

1. NUCLEAR CHARACTERISTICS OF FAST REACTOR USING VARIOUS FUELS M. Hirata p 1–7 refs (See N69-22442 11-22)

2. SWELLING OF OXIDE FUELS K. Inoue (Hitachi, Ltd.) p 8–12 refs (See N69-22443 11-22)

3. SWELLING IN CARBIDE FUELS H. Watanabe p 13–19 refs (See N69-22444 11-22)

4. DIFFUSION PHENOMENA IN NUCLEAR FUEL S. Yajima (Tohoku Univ.) p 20–28 refs (See N69-22445 11-22)

5. PHASE STUDY OF Pu O_2–UO_2 MIXED OXIDE FUEL AND ITS PHYSICAL PROPERTIES M. Koizumi p 29–40 refs (See N69-22446 11-22)

6. THE STRUCTURE AND THE VAPORIZATION OF THE CARBIDES OF URANIUM AND PLUTONIUM H. Tagawa p 41–52 refs (See N69-22447 11-22)

7. PREPARATION METHODS OF CARBIDE FUEL MATERIALS Y. Akimoto (Mitsubishi Metal Mining Co., Ltd., Omiya, Japan) p 53–62 refs (See N69-22448 11-22)

N69-22442# Japan Atomic Energy Research Inst., Tokyo.

NUCLEAR CHARACTERISTICS OF FAST REACTOR USING VARIOUS FUELS

M. Hirata *In its* Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 1–7 refs (See N69-22441 11-22) Avail: CFSTI

Critical mass, breeding ratio, peaking factor, and Doppler and fuel loss reactivity coefficients of UO_2, UC, UN, U_3Si_2, PuO_2–UO_2, PuC–UC and PuN–UN fueled cores being modeled by 1,000 MWe sodium cooled fast reactor are discussed under the condition of constant enrichment with change of core size. Carbide and nitride fueled core characteristics are more serviceable. Author

N69-22443# Hitachi, Ltd., Tokyo (Japan). Central Research Lab.

SWELLING OF OXIDE FUELS

K. Inoue *In* Japan Atomic Energy Res. Inst. Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 8–12 refs (See N69-22441 11-22)

Avail: CFSTI

Fuel swelling is the major design consideration for satisfactory irradiation performance of fast reactor fuels. Basic studies on the fuel swelling were performed by many investigators in each area of physical properties of fuel, fission product behavior, and bubble formation and migration. An approach to the swelling of oxide fuels is reviewed, the formulas for swelling are introduced. Author

N69-22444# Japan Atomic Energy Research Inst., Tokyo.

SWELLING IN CARBIDE FUELS

H. Watanabe *In its* Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 13–19 refs (See N69-22441 11-22)

Avail: CFSTI

Swelling in carbide fuels induced by fission gas bubbles and solid fission products was reviewed. The swelling due to the migration and coalescence of fission gas bubbles is strongly influenced by the fuel temperature and carbon content. The swelling rate increased with temperatures above 1,000°C and with decreased carbon contents below 4.7 to 4.8% carbon. The behavior of solid fission products is important at the temperatures up to 1,000°C, as the fraction of swelling induced by the solid fission products is larger than that by the fission gas bubbles. The swelling rate was calculated to be ≈0.4% ΔV/V per 1% burnup, and ≈1.3% ΔV/V per 1% burnup, without and with volatile fission elements respectively. Author

N69-22445# Tohoku Univ., Sendai (Japan). Research Inst. for Iron, Steel and other Metals.

DIFFUSION PHENOMENA IN NUCLEAR FUEL

S. Yajima *In* Japan Atomic Energy Res. Inst. Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 20–28 refs (See N69-22445 11-22)

Avail: CFSTI

A review of the studies of ion diffusion in uranium dioxide and other ceramic fuel materials is presented. Problems of experimental methods and the results of the studies are discussed. Author

N69-22446# Japan Atomic Energy Research Inst., Tokyo.

PHASE STUDY OF PuO_2–UO_2 MIXED OXIDE FUEL AND ITS PHYSICAL PROPERTIES

M. Koizumi *In its* Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 29–40 refs (See N69-22441 11-22)

Avail: CFSTI

If the hypostoichiometric mixed oxides containing more than 40% Pu are used as a fast reactor fuel, the fuels are considered to have changed phases together with changes of fuel properties, such as thermal expansion, thermal crack, thermal conductivity and gas release, on heating and cooling. The mixed oxides were studied by D.T.A., X-ray diffraction analysis, and thermal expansion measurement. During burn up, fission products are produced and built up in UO_2–PuO_2. Some of them form different oxide phases taking oxygen from UO_2–PuO_2, some segregate as metals, and others are volatile or stable as gas. The fission products and oxygen are forced to migrate by a steep temperature gradient and effect thermal conductivity, gas release, and swelling. Concentrations of fission product elements in UO_2–PuO_2 are calculated at 100,000 MWD/T burnup, and the fission products behavior is discussed. Author

N69-22447# Japan Atomic Energy Research Inst., Tokyo.
THE STRUCTURE AND THE VAPORIZATION OF THE CARBIDES OF URANIUM AND PLUTONIUM
H. Tagawa *In its* Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 41–52 refs (See N69-22441 11-22)
Avail: CFSTI

Phase diagrams, crystal structures and the vaporization of the carbides of uranium and plutonium are indicated and discussed. Mono- and di-carbides of uranium and mono- and sesqui-carbides of plutonium as the nonstoichiometric compound are described with emphasis on the phase diagram and the lattice parameter. Author

N69-22448# Mitsubishi Metal Mining Co., Ltd., Omiya (Japan). Central Research Lab.
PREPARATION METHODS OF CARBIDE FUEL MATERIALS
Y. Akimoto *In* Japan Atomic Energy Res. Inst. Proc. of the 2nd Seminar on Phys. Properties of Fast Reactor Fuels 1969 p 53–62 refs (See N69-22441 11-22)
Avail: CFSTI

The present status of knowledge on the preparation of uranium and plutonium monocarbides is reviewed. Emphasis is placed on three major preparative reactions: carbothermic, alkane, and elementary, and two major consolidation practices: sintering and arc melting. Relationships between the preparative methods and the quality of the carbides produced are discussed with emphasis on the partial oxidation and nitriding of carbide specimens. Methods for controlling the stoichiometry of the product are briefly discussed. Author

N69-22455# Kernforschungszentrum, Karlsruhe (West Germany).
HIGH-EFFICIENCY HYDRAULICALLY DAMPED SPRING BANK FOR BRAKING AND INTERCEPTING NUCLEAR REACTOR CONTROL RODS
O. Muehlhaeuser 1968 82 p refs Transl. into ENGLISH from the German
(EURFNR-530; EUR-3720; KFK-735) Avail: CFSTI

Damped spring components are required at 2 points in the core of a nuclear reactor: in the safety rod in order to brake the rod inserted in the case of scram shutdown; and underneath the fuel bundles in order to intercept any bundles which become detached, so that neither parts of the core nor the bundle itself is destroyed as they fall under gravity. The spring system developed consists of individual saddle-shaped warped disks, which, in the same way as plate springs, are grouped together in a bank and installed in a housing. The damping is effected by forcing out the liquid between the individual disks and the wall of the housing. The elasticity characteristics were determined theoretically and confirmed by measurements on a plexiglass model. The advantage of this type of spring compared with the others, e.g., helical springs, lies in the simple construction of the damping device, its insensitivity to rupture and its much improved efficiency compared with plate springs. Author (NSA)

N69-22507# Commissariat à l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucléaires.
THE PEGASE REACTOR LOOPS [LES BOUCLES DU REACTEUR PEGASE]
Nov. 1968 117 p refs In FRENCH; ENGLISH summary
(CEA-R-3564) Avail: CFSTI

After 4 years operation, experimentation and maintenance of the gas loops built especially for the nuclear fuel testing reactor Pegase, it appears desirable not only to gather together in a single document the essential characteristics and particularities of these devices and of their associated equipment, but also to give the reasons for the technical modifications and the way in which they were carried out; this is done here by the persons themselves who were responsible, day after day, for operating these loops. This essentially practical experience thus complements the careful research and preliminary testing carried out on these loops or on their prototypes. It should be of interest to those who deal with problems concerning design or operation of irradiation loops in experimental reactors or of similar equipment. Author (ESRO)

N69-22529# Oak Ridge National Lab., Tenn. Neutron Physics Div.
USE OF ICRU-DEFINED QUANTITIES AND UNITS IN SHIELDING
D. K. Trubey Oct. 1968 69 p refs
(Contract W-7405-ENG-26)
(ORNL-RSIC-16) Avail: CFSTI

The International Commission on Radiological Units and Measurements and the USA Standards Institute have offered definitions and made recommendations concerning nomenclature that should be adopted to the greatest extent possible in the shielding community. Because of the nuclear engineering context for shielding calculations and design, special problems have arisen. In order to help alleviate some of these problems, a review is presented along with recommendations. Some of these recommendations are controversial and do not represent a consensus of the many reviewers who have contributed to this work. These cases are identified. Discussions are given of terms such as flux density, dose, kerma, energy deposition coefficient, response functions, and buildup factors. Author (NSA)

N69-22555*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
NONDESTRUCTIVE DETERMINATION OF URANIUM 235 DISTRIBUTION BY FIXED POSITION GAMMA SCANNING
Paul J. Richardson and Dale C. Berner Washington Apr. 1969 8 p refs
(NASA-TM-X-1779) Avail: CFSTI CSCL 18I

A nondestructive method for determining fuel density variation in small, unirradiated, clad UO_2 plates is described. A plate is scanned at fixed positions instead of scanning a plate moving past a detecting system. Variations are calculated by a statistical sampling where it is not possible to analyze the whole plate. Author

N69-22560# Institute of Nuclear Research, Warsaw (Poland).
SPECTRUM INDEX Lu: Dy MEASUREMENTS IN WWR-SM CRITICAL ASSEMBLY CORES
Edward T. Jozefowicz 1968 11 p refs
(INR-895) Avail: CFSTI

The spectrum index Lu:Dy is measured in selected WWR-SM cores at some points in "normal" cells and is compared with the results of S-2 THERMOS code calculations. The measurements are also performed near the control rod, water channel and reflector and in the water trap. Author (NSA)

N69-22562# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
EVALUATION OF SPECIFIC POWER FOR GLASSY CERAMIC FUEL ELEMENTS [EVALUATIONS DE PUISSANCE SPECIFIQUE POUR LES ELEMENTS COMBUSTIBLES VITRO-CERAMIQUES]
S. Lungu 1968 9 p refs In FRENCH
(IFA-TR-55) Avail: CFSTI

Heat transfer characteristics and temperature distributions for a vitreous-ceramic fuel for a high temperature gas cooled reactor are determined. The equations for the temperature distributions are also derived.

N69-22584# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
APPROXIMATION OF FAST NEUTRON SPECTRUM OF REACTOR BY MEANS OF DIFFERENT MATHEMATICAL METHODS USING THRESHOLD DETECTOR DATA
I. Grancea and V. Cuculeanu 1968 16 p refs
(IFA-FR-65) Avail: CFSTI

Methods for determining the fast spectrum of the WWR-S research reactor are considered. For analysis of threshold detector data, the orthonormal function and orthonormal polynomial methods are described. The results of Legendre and Chebyshev calculations are compared. NSA

N69-22631# Commissariat a l'Energie Atomique, Saclay (France).
NONDESTRUCTIVE TESTING OF FLAT FUEL ELEMENTS BY AN INFRARED METHOD [CONTROLE NON DESTRUCTIF D'ELEMENTS COMBUSTIBLES PLAQUES PAR UNE METHODE THERMIQUE INFRA-ROUGE]
N. Chretien, J. F. Chretien, and P. Monnier 1968 17 p In FRENCH Presented at the Symp. on Nondestructive Testing and Control in the Field of Nucl. Met. and Technol., Saclay, France, 26 Jun. 1968
(CEA-Conf-1078) Conf-680606-6) Avail: CFSTI

Faulty binding or defects on plate fuel elements made up of a uranium core clad by Al sheets can be detected by a thermal method which shows up any parts of the element presenting abnormal heat transfer rates. Local heating is obtained by a light beam from a powerful pressurized Xe lamp focussed on the plate. On the other side of the plate, in line with the heating spot, point measurements of the temperature are made by analysis of the infrared radiation. The radiometer used includes a highly sensitive thermistor bolometer. The advantages of this non-destructive testing method are reviewed. Author

N69-22635# Commissariat a l'Energie Atomique, Grenoble (France).
EXPERIMENTAL STUDY OF THERMAL NEUTRON SPECTRA FROM COLD SOURCES OF LIQUID HYDROGEN AND DEUTERIUM
P. Ageron et al Apr. 1968 31 p Transl. into ENGLISH from CEA Report RHF-66-20
(NP-tr-1712; RHF-66-20) Avail: CFSTI

In order to investigate cold neutron sources for a high flux reactor, various moderators of liquid deuterium and hydrogen were investigated. The results obtained are reported as spectra, as gain factors from the ratio of cold spectrum to the spectrum leaving an unperturbed reflector, and as comparisons of different moderator chambers. The corrections made to the measured spectra are stated and the cryogenic design of the experiment and counting equipment are briefly described. Author (NSA)

N69-22640# California Univ., Livermore. Lawrence Radiation Lab.
LARGE SUPERCONDUCTING BASEBALL MAGNET, PART 1
C. D. Henning, R. L. Nelson, M. O. Calderon, A. K. Chargin, and A. R. Harvey 21 Mar. 1968 21 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-71010; Conf-680813-3) Avail: CFSTI

A 1.2-m-diam superconducting magnet is under construction as part of the Alice experiment in controlled thermonuclear fusion research. Shaped like the seam of a baseball, the magnet will produce a cusped magnetic field, close to 20 kG in the center, and up to 75 kG at the conductor. The superconductor, a 1/4-in.-square composite of niobium–titanium with copper, will carry 2400 amperes during partially stable operation. Previously, large magnets have been conservatively designed for total nucleate-cooling stability. However, in this instance, space limitations have demanded a more severe stability requirement. Other novel features of this magnet include the ability to vary the shape of the magnetic field and the use of a new high-manganese stainless steel for the force restraining structure. Author (NSA)

N69-22644# Atomics International, Canoga Park, Calif.
THERMAL COKING CAPSULE EXPERIMENTS ON ORGANIC REACTOR COOLANT
R. J. Sullivan and J. Guon 26 Apr. 1968 23 p refs
(AI-AEC-MEMO-12689) Avail: CFSTI

The thermal decomposition of irradiated U-3 coolant (Santowax OM) was tested in sealed capsules at 550 and 750°F for periods of 3, 6, and 11 months. Some tests were also made with unirradiated Santowax OM and capsules provided with relief valves. Little effect was observed at 550°F, but at 750°F extensive decomposition occurred leading to nearly complete solidification in six months. Rate constants were estimated for terphenyl disappearance and HB formation. Author (NSA)

N69-22742# Kernforschungszentrum, Karlsruhe (West Germany).
THE PROPERTIES AND PERFORMANCE OF THE HOT NEUTRON SOURCE AT THE FR2 REACTOR
O. Abeln, W. Drexel, W. Glaeser, F. Gompf, W. Reichardt et al *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 331–339 refs (See N69-22710 11-24)
(SM-104/69) Avail: CFSTI

For certain classes of neutron scattering experiments it is desirable to increase the neutron intensity at energies above the Maxwellian peak of a reactor spectrum. This can be done by installing a piece of moderator having a high temperature, a so-called hot source, at the tip of the beam tube. Graphite was used as material for the hot source. The possible gain in neutron intensity attainable with a hot source was studied in a mock-up experiment for various sizes and temperatures of the graphite block using the pulsed neutron technique. The agreement of the measurements with calculations of the rethermalization properties of the graphite block based on transport theory was quite satisfactory. A plug carrying a graphite cylinder, 18 cm in diameter and 18 cm in height, was installed at the FR2 reactor. With proper thermal isolation a graphite temperature of about 1700°K was reached by nuclear heating only. Spectrum measurements at this temperature and systematic studies of the properties of the hot source are under way. An increase in neutron intensity of about a factor of 7 is expected at a neutron energy of 0.3 eV. The source will be first used for phonon dispersion measurements. Author

N69-22743# Atomic Weapons Research Establishment, Aldermaston (England).
THE DESIGN AND PERFORMANCE OF THE HERALD COLD SOURCE
F. Davies, A. L. Rodgers, M. C. J. Tedd, D. K. Rees (Birmingham Univ.), Y. Sanalan (Birmingham Univ.) et al *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 341–352 refs (See N69-22710 11-24)
(SM-104/116) Avail: CFSTI

A liquid hydrogen/deuterium cold source was installed in one of the tangential beam tubes of the reactor HERALD at AWRE, Aldermaston. The design and construction of the refrigerator and cold source assembly are described and the operating experience is outlined. Measurements were made of the neutron spectra from ambient sources and from cold sources using apparatus installed at both ends of the beam tube. On the long wavelength apparatus for defect studies the neutron spectra were measured

in the range 6 to 15 Å using a mechanical velocity selector. At the other end of the tube the inelastic neutron scattering apparatus was used to measure the neutron spectra between 4 and 8 Å using high resolution time-of-flight equipment. The total cold neutron intensity transmitted by the cold beryllium filter was also recorded on the latter apparatus. Initially measurements were made on a series of ambient temperature sources to establish a reference point from which to estimate the overall gain and the gain as a function of wavelength. Measurements were also made on a number of mixtures ranging from 100% liquid hydrogen to 100% liquid deuterium. An optimum mixture was found. The fluxes obtained from the cold source are 20 to 30 times greater than from ambient sources. The gain is independent of wavelength in the range 6 to 15 Å. Author

N69-22744# Commissariat a l'Energie Atomique, Saclay (France).
DESCRIPTION AND NEUTRON CHARACTERISTICS OF A NEUTRON GUIDING TUBE AT THE EL3 REACTOR [DESCRIPTION ET CARACTERISTIQUES NEUTRONIQUES DU TUBE CONDUCTEUR DE NEUTRONS INSTALLE PRES DU REACTEUR EL3]
B. Famoux, B. Hennion, and J. Fagot *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 353-380 refs In FRENCH; ENGLISH summary (See N69-22710 11-24)
(SM-104/30) Avail: CFSTI

A neutron guiding tube that provides a more intense and better filtered beam of slow neutrons than that obtained by a classical method is considered for construction at the channel exit of an EL3 reactor. A short summary of the operating principles of a guiding tube and the description of the mechanical and technical characteristics of the apparatus is given. The neutron background at the experimental post was measured and the neutron energy spectrum at the exit of the tube was measured by the time-of-flight method. The intensity distribution of thermal neutrons and for cold neutrons in a horizontal plane was determined and the neutron flux and the transmission of the device were calculated. Author

N69-22782# Westinghouse Research Labs., Pittsburgh, Pa.
DECAY HEAT TRANSFER FROM REACTOR FUEL RODS IN TEST HOLDERS IN A HOT CELL (LWBR DEVELOPMENT PROGRAM)
A. T. Pieczynski and W. A. Stewart 23 Sep. 1968 59 p refs
(Contract AT(11-1)-GEN-14)
(WERL-TAADM-1) Avail: CFSTI

Temperatures were measured on electrically heated models of nuclear fuel rods in three types of rod holders for the conditions obtained with various rates of decay heating when rods and holders rest horizontally or vertically on the floor of a hot cell. Theory describing the heat transfer by free convection and radiation inside and outside the holders is derived and tested. Fin conduction theory for heated and unheated fuel element lengths was derived and applied. Model rod emissivity was measured. Correlations of the data on the transfer from a single rod and from the holders agreed well with calculated results. The small fractions of heat transferred from holder to the floor and convected to air circulating through a holder were determined experimentally. Correlations for heat transfer with the holders and rods used by the Bettis Atomic Power Laboratory permit determination of the time when they may be removed to a hot cell without exceeding a prescribed temperature. Author (NSA)

N69-22783# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
GROUP CONSTANTS FOR STEAM- AND SODIUM-COOLED FAST REACTORS (26-GROUP REPRESENTATION)
H. Huschke, comp. Apr. 1968 138 p refs Work performed under US-Euratom Fast Reactor Exchange Program
(EURFNR-533; EUR-3953; KFK-770) Avail: CFSTI

A 26-group spectrum obtained by using the Russian ABN-Karlsruhe KFK-26-10 group sets is applied to establish the collision density spectrum for steam-cooled fast reactors. The 26-group set is designated KFK-SNEAK. The group constants for the isotopes H, C, O, Na, Al, Cr, Fe, Ni, ^{235}U, ^{238}U, and ^{239}Pu are recalculated and presented. When applied to liquid sodium-cooled reactors, the KFK-NAP set is formed. NSA

N69-22794# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
METHOD FOR THE EXPERMENTAL STUDY OF THE NATURAL FREQUENCIES, NORMAL, AND EXPANSION FUNCTIONS AND THE DAMPING OF TRANSVERSELY OSCILLATING FUEL RODS
J. Kadlec and V. Pfrommer Mar. 1968 30 p Work performed under US-Euratom Fast Reactor Exchange Program
(EURFNR-529; EUR-3718; KFK-731) Avail: CFSTI

Problems relating to experimental studies on the natural frequencies and the corresponding eigenfunctions of transversely oscillating fuel rods which are supported at several points by spacers are presented. A description is given of the test rig and the results obtained. An electromagnetic exciter system is used in order to achieve the oscillating state in the fuel rod. Author (NSA)

N69-22796# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
FUEL MANAGEMENTS FOR AN ORGEL PROTOTYPE ORIENTATION STUDY
B. Chambaud, J. C. Charrauvt, A. Degressin, and P. Tauch Brussels 1968 38 p refs
(Proj. Orgel)
(EUR-4204.e) Avail: CFSTI

A comparison is made in order to assess the economical and technological potential of an ORGEL reactor operated with different fuel managements. All cases are normalized to plants of 250 MWe gross. Three managements are considered: on-power refuelling with axial shuffling (MA), on-power refuelling with radial shuffling (MR), and off-powar refuelling with batchwise shuffling (SR); moreover, the influence of variable fuel enrichment and radial reflector thickness is investigated. A first comparison in terms of fuel enrichment shows the predominant economic position of the MA management under the hypothesis of fuel burn-up being limited only by the reactivity potential. A second comparison envisages technological restrictions which limit the maximum local burn-up of the external rods in the fuel bundle. A low burn-up region is clearly dominated by the MR management; in a transition zone the MR and MA management are economically equivalent; above a maximum local burn-up the MA management is more attractive. Author

N69-22797# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).
INVESTIGATIONS ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS Annual Report, 1967 [UNTERSUCHUNG AN ZYKLONEN ZUR DAMPFABSCHEIDUNG IN SIEDEWASSERREAKTOREN. JAHRESBERICHT, 1967]
Brussels 1969 70 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-083-66-1-TEED)
(EUR-3992.d) Avail: CFSTI

This report describes theoretical and experimental developments on a down-flow cyclone-type steam separator for boiling water

reactors (BWR). The cyclones are arranged in three concentric rows on top of the downcomer annulus between the reactor core and the pressure vessel in the 600 MWe BWR. The flow distribution among the three rows of cyclones was investigated in an air-water test loop as a function of reactor power. The best results were obtained with a concentric baffle arrangement above the core, dividing the core outlet flow into three nearly equal parts. Theoretical studies were also undertaken with a view toward a further increase of the cyclone ratings. Author

N69-22799# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

DEPOSITION OF FISSION ENERGY IN AN ORGEL TYPE REACTOR

B. Haytink and E. Schmidt Brussels 1968 37 p refs
(Proj. Orgel)
(EUR-4208.e) Avail: CFSTI

The source strengths for the individual kinds of energy liberated by the fission process are summarized. A calculation model for their deposition in an ORGEL-type reactor is explained and the numerical results for the 250 MWe-ORGEL prototype are given, which will permit the evaluation of the decomposition rates for the organic coolant in this reactor type. Author

N69-22800# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

THESEE 2: A CALCULATION CODE FOR PERFORMANCES AND THERMOHYDRAULIC PERTURBATIONS OF AN ORGEL REACTOR CHANNEL [THESEE 2: CODE DE CALCUL DES PERFORMANCES ET DES PERTURBATIONS THERMOHYDRAULIQUES D'UN CANAL DE TYPE ORGEL]

B. Chambaud and P. Civardi Brussels 1968 98 p In FRENCH; ENGLISH summary
(EUR-400.f) Avail: CFSTI

Formulas are presented for determining the following factors: (1) fine distribution of the organic coolant temperatures of a cluster fuel element; (2) fine distribution of the cladding temperatures around the most charged channel, taking into account the local velocity distribution; and (3) the average thermohydraulic performances of the channel of an ORGEL type reactor. Author

N69-22818# Argonne National Lab., Ill.

ENGINEERING DEVELOPMENT OF FLUID-BED FLUORIDE VOLATILITY PROCESSES. PART 13. PILOT PLANT STUDIES OF THE FLUORINATION OF URANIUM OXIDE WITH BROMINE PENTAFLUORIDE

John T. Holmes, Lowell B. Koppel, N. Saratchandran, James B. Strand, and D. Ramaswami May 1968 94 p refs
(Contract W-31-109-ENG-38)
(ANL-7370) Avail: CFSTI

Engineering-scale studies were performed in a 3-in. diameter fluid bed reactor facility to determine the effects of important process variables on the oxidation of crushed UO_2 pellets to U_3O_8 fines in an oxygen–nitrogen stream and the subsequent fluorination of the U_3O_8 with BrF_5 diluted with nitrogen. A fluidized bed of inert alumina served as a heat transfer medium for the exothermic chemical reactions. The work with BrF_5 consisted of a fractional factorial experiment of eight runs to determine the effects of six process variables on UF_6 production rate, BrF_5 utilization efficiency, and the reaction-rate constant. Favorable conditions for the BrF_5 fluorination are: a temperature of 300°C, an inlet BrF_5 partial pressure of 0.29 atm, a fluidizing gas velocity of 0.89 ft/sec, and a UO_2 charge of 4.4 kg. The expected average UF_6 production rate and average BrF_5 utilization efficiency for fluorinating the first 50% of the uranium are 185 lb/(hr)(ft²) of UF_6 and 75%, respectively. Author (NSA)

N69-22828# Technische Hochschule Munchen (West Germany). Institut fuer Radiochemie.

APPLICATION OF MECHANICAL SEPARATION AND SOLID-STATE REACTIONS TO THE REPROCESSING OF CERAMIC NUCLEAR FUELS

F. Lux and H. Wuermeaher Mar. 1968 54 p refs In GERMAN
(BMwF-FBK-68-08) Avail: AEC Depository Libraries

The system uranium dioxide–uranium carbide–graphite–irradiation products of uranium was examined between 1000 and 2300°C; the macroscopic solid phases were finely divided. Mechanical data such as grain distribution, density, intergrowth etc. and conditions of reactions in the system were determined. A method for solid-solid separation was developed for the system. Below 2000°C the following values were found for the release of nonvolatile fission products from the neutron irradiated phase: 100% Ba, 26% Zr/Nb, 16% Mo, 51% Ru, 51% Ce, 70% Nd. It was possible to explain the release by microscopic heterogeneous solid state reactions. The possible application of these results to reprocessing of nuclear fuel is discussed. Author (NSA)

N69-22830# Kernforschungsanlage, Juelich (West Germany). Arbeitsgruppe Dekontamination.

STUDIES CONCERNING THE CHEMICAL OXIDATION PROCESS FOR TREATING RADIOACTIVE SEWAGE [UNTERSUCHUNGEN ZUM VERFAHREN DER CHEMISCHEN OXYDATION VON RADIOAKTIVEN FAEKALABWAESSERN]

R. Schulze-Rettmer and W. Schlenter Aug. 1968 40 p refs In GERMAN
(JUL-544-DE) Avail: CFSTI

The radioactive sewage of the radiology clinic of this facility is treated in a special plant by a chemical oxidation process. Ammonium peroxodisulfate is added to the sewage at a temperature of 80° C, resulting in the oxidative reduction of the biological components. A patent application has been filed for this method. In this report, the optimum operating conditions for this method as determined in the laboratory are described. Special analytical methods for controlling the effectiveness of the method were established. Oxidation experiments were also conducted with potassium peroxodisulfate and with peroxodisulfuric acid. Detailed descriptions are presented of the composition of the slush, stability and hydrolytic decomposition of some peroxodisulfate compounds, behavior of iodine in this process, and the effects of peroxodisulfate on the analytical determination of oxidative processes. Transl. by K.W.

N69-22831# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorwerkstoffe.

MODULUS OF ELASTICITY MEASUREMENT ON THE OUTER LAYER OF SINGLE, COATED NUCLEAR FUEL PARTICLES PERPENDICULAR TO THE SURFACE [MESSUNG DES ELASTIZITAETSMODULS DER AEUSSEREN SCHICHT AN EINZELNEN KERNBRENNSTOFFTEILCHEN (COATED PARTICLES) SENKRECHT ZUR OBERFLAECHE]

W. Delle, K. Drittler, G. Haag, and H. Schiffers Nov. 1968 22 p refs In GERMAN
(JUL-562-RW) Avail: CFSTI

An experimental method for determining the modulus of elasticity of coated fuel particles is described. The particle is pressed between two planes, and the modulus of elasticity perpendicular to the surface of the exterior layer of the particle is derived from the depth of impression and the force of the pressure. A requirement

is that the depth of the impression is small compared with the thickness of the outer layer. The resulting values are in good agreement with available measurements of the elasticity modulus parallel to the separation surface in case of pyrocarbon chips. Transl. by K.W.

N69-22891# Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.
PROPERTIES AND FABRICATION OF TM-170 FUEL FORMS
J. R. Keski and P. K. Smith 3 Jun. 1968 20 p refs Presented at the Nucl. Met. Symp. on Mater. for Radioisotope Heat Sources, Gatlinburg, Tenn.
(Contract AT(07-2)-1)
(DP-MS-68-24; CONF-681002-2) Avail: CFSTI

Natural thulium sesquioxide is a candidate target material to produce ^{170}Tm fuel forms for direct application in short-lived radioisotopic heat sources. Physical and chemical properties of Tm_2O_3 are reviewed. Fabrication methods for oxide wafers of 97% of theoretical density and characteristics of wafers irradiated to an activity of about 2 W/g are described. Author (NSA)

N69-22897# Argonne National Lab., Ill. Reactor Physics Div.
ADDENDUM TO THE REPORT ON HIGH CONVERSION CRITICAL EXPERIMENTS
K. E. Plumlee
Aug. 1968 10 p refs (Contract W-31-109-eng-38)
(ANL-7302-Add) Avail: CFSTI

This addendum presents revised results for the conversion ratio measurements previously reported. All the results have been revised downward, by net relative reductions of ≈ 4%–15%. The revision is necessary because of the application of a more appropriate method of data analysis than originally used. The improved analysis adjusts accurately for the epicadmium flux component in graphite thermal columns, which affected the reference irradiations used for normalization of these measurements. The revised results for initial conversion ratios range from 0.44 ± 0.01 to 1.25 ± 0.04 for $H:U^{235}$ atom ratios of 4.16 down to 0.50 (which is a subcritical composition), using 3.04 w/o enrichment UO_2 fuel and H_2O moderator and reflector. The UO_2 pellet diameter was 0.935 cm, and an average of 853.3 g was contained as a 121.9-cm length column in each fuel element. The cladding was 1.06-cm-OD stainless steel with 0.05-cm wall thickness. Author

N69-22911# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
SNAP-21 PROGRAM, PHASE 2. DEEP SEA RADIOISOTOPE-FUELED THERMOELECTRIC GENERATOR POWER SUPPLY SYSTEM Quarterly Report, 1 Jul.–30 Sep. 1968
Oct. 1968 149 p refs
(Contract AT(30-1)-3691)
(MMM-3691-29; QR-9) Avail: CFSTI

Equipment and procedures are tested for the SNAP-21 power unit. Fuel capsules were fabricated, and also pressure vessels and shipping containers were made. Thermal insulation, thermocouples, and thermoelectric cells were tested for this power source. A designs for a thermoelectric power generator are included. NSA

N69-22927# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
ACOUST: A DIGITAL PROGRAM FOR ACOUSTIC TRIANGULATION OF NUCLEAR VESSELS
E. V. Waite and K. V. Moore Nov. 1968 19 p refs
(Contract AT(10-1)-205)
(IDO-17280) Avail: CFSTI

A structural fault, when deformed, will generate acoustic emissions. ACOUST was written to locate the structural fault through the implementation of hyperbolic triangulation on the time-of-arrival differences between a fault and three acoustic sensors. The code is designed to operate on a cylindrical vessel with (or without) capped end sections. The program is written to permit any type of end section geometry, and the program is designed to permit acoustic sensor locations on pipes leading to or from the test vessel. One transducer (per set of three) may be located on a vessel end section. ACOUST is a FORTRAN IV digital computer program written for usage on the IBM 7044. The program occupies 10,343 octal memory locations. Standard input/output assignments are used in the program. The computer usage time required for each solution varies from five seconds to one minute, depending on the complexity of the particular problem. Only the 7044 version of the program is available. Author (NSA)

N69-22948# Atomics International, Canoga Park, Calif.
PREPARATION OF UC AND UC-W- SPECIMENS FOR AN IRRADIATION TEST OF THE VALUE OF A FINE-PARTICLE DISPERSION IN THE CONTROL OF FISSION GAS SWELLING (EXP-NRX-9-101 EXPERIMENT)
A. C. Hott 31 May 1968 41 p refs
(Contract AT(04-3)-701)
(NAA-SR-12629) Avail: CFSTI

The preparation and characterization of fuel samples for an irradiation test of fission gas swelling in tungsten-doped uranium monocarbide are described. Details are given on the arc melting and casting and the zone melting processes used to prepare the 0.33-in. diameter fuel slugs. Electron micrographs are presented which show the presence of fine particles. The fuel samples have been further characterized by chemical analysis, optical metallography, length measurement, and density determination. Density change is the chief measure of the swelling which occurs during irradiation, and the comparison of the swelling of the tungsten-containing samples with that of the control samples is the chief indication of the value of tungsten additions for the reduction of fuel swelling. The density and other properties of the 114 fuel slugs for use as reference data during the postirradiation examination are given. Author (NSA)

N69-22980# Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Strahlenschutz.
WORK SUMMARY 1967, OF THE CENTRAL DIVISION FOR RADIATION PROTECTION [ARBEITSBERICHT 1967, DER ZENTRALABTEILUNG STRAHLENSCHUTZ]
K. Keller and R. Tzschaschel Aug. 1968 209 p refs in GERMAN
(JUL-543-ST) Avail: CFSTI

Radiation control activities, equipment, and supporting research and development are summarized. The control measures consisted of sampling of radioactivity at selected points in the vicinity of the facility, control of reactor operations and research facilities, and personnel dosimetry. Detailed sampled data are presented for air, water, soil, and agricultural products. Internal and external personnel dosimetry is described, and the operations of the chemical laboratory and the instrument and equipment section are explained. As part of the supporting research, several new methods and improved instrumentation were developed for the dosimetry of radiation fields, analytical radioactivity measurements, atmospheric contamination studies, and radiation shielding. A complete bibliography of scientific publications, internal reports, laboratory reports, and conference papers for the year is also presented. Transl. by K.W.

N69-22968# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
ERUPT: A TWO-DIMENSIONAL, TWO-ENERGY GROUP FUEL MANAGEMENT PROGRAMME FOR THE IBM 360 COMPUTER
W. Boettcher, A. Decressin, and F. Lafontaine 1968 41 p refs
(Proj. ORGEL)
(EUR-4203.E) Avail: CFSTI

The ERUPT is a program for survey calculations of fuel management on a two-dimensional model of a reactor core. The number of energy groups is two. Automatic computation of a variety of fuel management schemes is made possible, with and without fuel shuffling. The codification is in FORTRAN 4 for the IBM-360/65 computer. Author

N69-22987# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
CODE DIFHYD: METHOD FOR THE CALCULATION OF HYDROGEN DIFFUSION IN A FINNED LINER TUBE OF ZIRCONIUM ALLOY [CODE DIFHYD: METHODE POUR LE CALCUL DE LA DIFFUSION DE L'HYDROGENE DANS UN TUBE-GUIDE A AILETTES EN ALLIAGES DE ZIRCONIUM]
M. F. Jamet and M. Lecloux 1968 103 p refs In FRENCH; ENGLISH summary
(Proj. ORGEL)
(EUR-4202.F) Avail: CFSTI

DIFHYD is a code for the parametric study of hydrogen diffusion in finned zirconium liner tubes. The calculation based on the method of finite differences gives the following results: (1) temperature distribution in the assembly of liner tube, gas insulation and calandria tube is a function of the organic and heavy water temperatures and (2) distribution of hydrogen concentrations, taking into account the temperature and the flow of hydrogen entering the surface of the liner tube and supposing that the limit of hydrogen solubility in Zr is reached at the tips of the fins. Author

N69-22998# Los Alamos Scientific Lab., N. Mex.
THE LASL PLUTONIUM-238 FUEL DEVELOPMENT PROGRAM
Oct. 1968 48 p refs Presented at Plutonium-238 Isotopic Fuels and Heat Source Program Rev., Washington, D. C., 29–30 Oct. 1968
(Contract -7405-ENG-36)
(LA-DC-10048; CMB-11-9455; Conf-681022-1) Avail: CFSTI

A definition of solid solution fuel is given. A reference fuel composition of calcium oxide stabilized PuO_2–ZrO_2, at a Pu concentration corresponding to a power density of 1.7 watts/cc has been fabricated in pellets, with and without axial holes. Other specimens were fabricated into thin wafers, and large discs in two sizes. Compositions equivalent to 3.5 and 4.4 watts/cc have been fabricated. Properties presented on the PuO_2–ZrO_2 fuel are crystallography, microstructure, chemical composition, density, thermal properties, and compatibility. Plutonium-238 specimens are also being tested for helium migration, thermal diffusivity, and sea water solubility. Calculated and estimated properties on thermal conductivity for PuO_2–ZrO_2 and PuO_2–ThO_2 fuels are summarized. Specimens are listed which are to be safely tested. NSA

N69-23084# Commissariat a l'Energie Atomique, Chuscian (France). Centre de Production de Plutonium de Marcoule.
DETECTION OF RADIOACTIVE GASES IN THE CO_2 COOLANT OF THE G2-G3 REACTORS [DETECTION DES GAZ RADIOACTIFS DAN LE CO_2 DE REFROIDISSEMENT DES PILES G2-G3]
Jacques Pouthier and Jacky Rossi Sep. 1968 28 p refs In FRENCH
(CEA-R-3556) Avail: AEC Depository Libraries

The CO_2 cooling the reactors G2–G3 contains activation gases and fission gases. Gas-phase chromatography is applied daily for carrying out analyses. The chromatogram has separate peaks due to T, $^{41}A_r$, ^{85}Kr, ^{133}Xe, and ^{135}Xe. By integrating each peak it is possible to calculate the specific activity of each product. the construction of an apparatus for carrying out continuous measurements is under consideration. Author (NSA)

N69-23120# California Univ., Livermore. Lawrence Radiation Lab.
HEAT PIPE RADIATOR FOR SPACE POWER PLANTS
Richard W. Werner and Gustav A. Carlson 16 May 1968 17 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-71004; Conf-680802-4) Avail: CFSTI

A heat pipe radiator which forms the tertiary loop of a Rankine power system and furnishes meteoroid protection and fluid isolation of the secondary loop is discussed. The radiator design is usable over a broad range of power and its fabrication is well within current technology. A representative value of specific weight which includes feed lines, return lines, manifolds and heat pipes is ~1.1kg/kW(e) considered for a 20,000 hour mission at 1100°K with a probability of no critical penetrating hits of 0.99. Author (NSA)

N69-23121# Ceskoslovenska Akademie Ved, Rez.
DYNAMICS OF THE HYDRAULIC SYSTEM AND OPTIMISATION OF THE CONTROL OVERFLOW AT THE TR-0 REACTOR: NUMERICAL SOLUTION
M. Zikan, J. Pfann, and M. Krejci Jan. 1968 95 p refs In CZECH
(UJV-1944) Avail: CFSTI

Evaluation of the dynamics of the hydraulic system with regard to its control quality and choice of optimum design parameters is presented. Experimental data and digital computer calculations for differential equations are also presented. Author (NSA)

N69-23122# Los Alamos Scientific Lab., N. Mex.
A REPORT TO THE VIENNA PANEL ON URANIUM-CARBON AND PLUTONIUM-CARBON SYSTEMS, 1968
Edmund K. Storms [1968] 46 p refs
(Contract W-7405-ENG-36)
(LA-DC-9724; Conf-680924-2) Avail: CFSTI

The phase relationship of the U–C system is discussed and previous data are cited on phase diagram and crystal structure. Thermochemical properties of UC, U_2C_3, and UC_2 are summarized. The phase relationship of the Pu–C system is discussed. Thermochemical properties of Pu_2C_3 + C, PuC_2 + C, and PuC + Pu_2C_3 are discussed. A bibliography is included. NSA

N69-23123# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
PEGASE: SAFETY STUDIES; EXPERIMENTAL STUDY OF BURN-OUT RISKS IN TRANSIENT OPERATION [PEGASE – ETUDE DE SURETE, ETUDE EXPERIMENTALE DES RISQUES DE BURN OUT EN REGIME TRANSITOIRE]
Philippe Vernier Sept. 1968 87 p refs In FRENCH
(CEA-R-3477) Avail: AEC Depository Libraries

An experimental out-of-pile set-up is proposed simulating the breakage of a pipe supplying the core of the reactor PEGASE. The two fast phenomena, depressurization of the vessel and flow reversal are reproduced. The Al heating channel has the same shape as that of the reactor channel but has twice the heat

capacity. The starting conditions are V = 4, 50 and 6 m/sec, T_E = 50 and 60°C and P_E = 4 bars. The results show that the critical flux ϕ_0 varies with the flow-rate from 45 to 60 W/cm² in the case where there is no power reduction. For fluxes of 90 W/cm² the results lead to the conclusion that the hot channel attains a state of burnout after 0.1 sec and that its temperature reaches 500°C in 0.8 sec. The hydrodynamic conditions of the channels after the accident involve periodic expulsion (0.2 to 0.5 sec), characteristic of boiling at low pressure. Author (NSA)

N69-23129# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

SYNTHESIS OF ORGANIC COOLANTS FOULING STUDIES [SYNTHESE DES CONNAISSANCES RELATIVES A L'ENCRASSEMENT AVEC LES FLUIDES ORGANIQUES]

J. F. Terrien 1968 85 p refs In FRENCH; ENGLISH summary (Proj. ORGEL)
(EUR-4206.f) Avail: CFSTI

A review of the most pertinent data on fouling with organic liquids is indertaken. Different fouling mechanisms are presented and compared to the experimental data. It is found that, besides the role of the radiations, the coolant quality and its purification are the most important parameters for controlling the film formation rate. Different purification units are reviewed and analyzed. Author

N69-23133# General Electric Co., Cincinnati, Ohio. Missile and Space Div.

AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM Progress Report, 1 Feb.–30 Apr. 1968

29 Jun. 1968 195 p refs
(Contract AT[40-1]-2847)
(GEMP-1006; PR-74) Avail: CFSTI

Evaluation and testing of high-temperature physical and mechanical properties of materials for use in fueled and non-fueled reactor applications include Mo, W, Re, Re–W, Mo–Re–W, and stainless steels. Radiation effects on fast breeder reactor cladding and structural materials are investigated. Information is presented on creep-rupture of Incoloy 800, plastic fatigue of Type 316 stainless steel, creep-rupture of polycrystalline Mo, isochronal resistivity recovery of Mo, and microhardness of Mo–Ti, V, and W. Tubing of Re–W and Mo–Re–W development procedures are given. Removal of carbon impurities from Mo was studied in moist hydrogen and argon atmospheres. Creep-rupture results on chromium-base alloys for fuel cladding materials are given. Tensile data and Poisson's ratio were obtained for AISI 304, 316, and 348 stainless steel at strain rates and temperatures corresponding to those used in fatigue testing. NSA

N69-23137# California Univ., Livermore. Lawrence Radiation Lab.

INVESTIGATION OF PERFORMANCE OF AN OUT-OF-CORE THERMIONIC SPACE POWER SYSTEM

William E. Loewe 18 Mar. 1968 24 p refs Submitted for publication Supported by AEC
(UCRL-70984; Conf-680802-5) Avail: CFSTI

Conceptual designs of out-of-core thermionic space power generators using heat pipes have been produced for various powers, temperatures, and constraints or parameter values. Since major impediments to in-pile thermionic systems are alleviated or eliminated in the out-of-core concepts, a competitive degree of feasibility and competitive specific masses are adequate to establish the need for emphasis on these systems in future studies and development activities. Feasibility in the six cases shown in conceptual detail appears to be limited only by lithium heat pipe feasibility and a favorable outcome of current technology development of UN, W, and Li materials in the temperature range considered. For example, one man-rated system at 300 KW(e) and 1800°K shows a specific mass of 7.9 kg/KW(e) and will accommodate an 18 m payload at a 50 m distance. Author (NSA)

N69-23140# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

THESEE 3: A CALCULATION CODE FOR NOMINAL PERFORMANCES AND STATISTICAL HOT CHANNEL FACTORS OF AN ORGEL REACTOR CHANNEL [THESEE 3: CODE DE CALCUL DES PERFORMANCES NOMINALES ET DES FACTEURS DE POINTS CHAUDS STATISTIQUES D'UN CANAL DE TYPE ORGEL]

B. Chambaud 1968 88 p refs In FRENCH; ENGLISH Summary (Proj. ORGEL)
(EUR-4201.F) Avail: CFSTI

The Thesee 3 code is programmed in FORTRAN 4 language for the IBM 360 computer. The organic coolant and sheath fine distribution temperatures of a cluster fuel element are determined. The average thermohydraulic performances of the channel of an Orgel–reactor and also, the fabrication tolerances statistical influence on the performances and particularly on the nominal sheath temperature are calculated. Author

N69-23141# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

PERFOR 2: A CALCULATION CODE FOR PERFORMANCES OF AN ORGEL TYPE REACTOR. NOMINAL PERFORMANCES, PERTURBATIONS AND STATISTICAL HOT CHANNEL FACTORS [PERFOR 2: DODE DE CALCUL DES PERFORMANCES D'UN REACTEUR ORGEL. PERFORMANCES NOMINALES PERTURBATIONS ET FACTEURS DE POINTS CHAUDS STATISTIQUES]

B. Chambaud 1969 160 p refs In FRENCH; ENGLISH Summary
(Proj. ORGEL)
(EUR-4223.F) Avail: CFSTI

The Perfor 2 code programmed in FORTRAN 4 language for the IBM 360 computer determines the organic coolant temperatures' fine distribution of a cluster fuel element. The cladding temperatures' fine distribution around the most charged channel taking into account the local velocity distribution and the fabrication tolerances' statistical influence on the performances and particularly on the nominal sheath temperature are calculated. The average thermohydraulic performances of the channels of an Orgel-type reactor and the total performances of the reactor are also determined. Author

N69-23142# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

MAIN CODES DEVELOPED WITHIN THE ORGEL PROJECT REACTOR DESIGN [PRINCIPAUX CODES DEVELOPPES DANS LE CADRE DU PROGRAMME ORGEL UTILISES POUR LES CALCULS DU PROJECT]

M. F. Jamet 1968 107 p ref In FRENCH; ENGLISH Summary (Proj. ORGEL)
(EUR-4211.F) Avail: CFSTI

The heavy water-organic cooled reactors, those being elaborated either by Euratom's services or by contact, in the frame of the Orgel program is presented. If certain existing codes do not figure in this list, it is because they were replaced, in the course of the studies, by others being better adapted, or because they are of no direct use in the studies of reactor projects. For each code the author's name is indicated in the section titled. Identification, the author is the person who conceived the program and supervised code elaboration. The reader should preferably contact this person for

any further information needed. The authors of auxiliary program listed in the section titled, Informations Specifiques, were not mentioned. Author

N69-23144# Comitato Nazionale Per l'Energia Nucleare, Rome (Italy).
COORDINATION OF ACTIVITIES IN THE FIELD OF ELECTRONICS AND INSTRUMENTATION. 2: AUTOMATION AND CONTROL [COORDINAMENTO DELLE ATTIVITA NEL CAMPO DELL'ELETTRONICA E DELLA STRUMENTAZIONE. 2: AUTOMAZIONE E CONTROLLO]
B. Rispoli 1967 114 p refs In ITALIAN
(RT/EL-(67)14) Avail: CFSTI

A series of meetings were held to coordinate work and research at Italian laboratories on the automation of nuclear processes and experiments. Papers presented reviewed the work at Casaccia, Frascati, Bologna, and the Ionizing Gas Laboratory. Summaries were given of papers published on optimum synthesis method for a threshold element in the presence of noise, electronic complexes with modular structure for the automation of nuclear experiments, and adaptive threshold elements (iterative procedure, adaptive elements, analog multipliers, and automatic scanner for nuclear emulsions). Three papers were presented in full, and these were distributed under the report numbers RT/EL-(67)11, RT/EL-(67)12, and RT/EL-(67)13. NSA

N69-23151# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
THEORETICAL STUDY OF THE DIFFUSION OF HYDROGEN IN A ZIRCONIUM ALLOY LINER TUBE: HYDROGEN SINKS AND EFFECT OF JOINTS [ETUDE THEORIQUE DE LA DIFFUSION DE L'HYDROGENE DANS UN TUBE-GUIDE EN ALLIAGE DE ZIRCONIUM: PUITS D'HYDROGENE ET EFFET DES JONCTIONS]
B. Huber and M. F. Jamet 1968 39 p refs In FRENCH; ENGLISH summary
(Proj. ORGEL)
(EUR-4207.F) Avail: CFSTI

The extraction of the hydrogen originating from the corrosion of the liner tube in the organic coolant by means of fins welded to the outside of the tube (hydrogen sinks) is studied. The distributions of temperature and hydrogen concentration are calculated with the code Difhyd. A parametrical study and the design of hydrogen sinks for the channel of the ORGEL prototype are given. The propagation along the liner tube of the hydrogen absorbed at the zirconium alloy/steel joints is calculated. Author

N69-23156# Kernforschungszentrum, Karlsruhe (West Germany).
EXPERIMENTAL INVESTIGATION OF THE SAFETY SYSTEMS OF THE FR2 (CORE WITH UO_2-FUEL ELEMENTS) [EXPERIMENTELLE UNTERSUCHUNGEN AM SICHERHEITSSYSTEM FR 2 (CORE MIT UO SUB 2 BRENNELEMENTEN)]
W. Steiger and D. Wildberg Jun 1968 26 p refs In GERMAN
(KFK-782) Avail: AEC Depository Libraries

The uranium oxide loaded core for the FR-2 is described; a cross section of the core is given. Neutron flux plots are shown as a function of time for both log and linear channels. Results of period channel measurements are shown graphically. Schematics of the safety circuit are given. Flux and period channel data are tabulated, also. NSA

N69-23164# Ceskoslovenska Akadmie Ved, Rez. Ustav Jaderneho Vyzkumu.
THERMAL CALCULATIONS OF FUEL ELEMENT RODS [ZPRESENY TEPELNY VYPOCET TRUSKOVEHO PALIVOVEHO CLANKU]
P. Pecha Sep. 1968 41 p refs In CZECH.
(UJV-2023-R) Avail: AEC Depository Libraries

A method for performing thermal calculations for a fuel element consisting of concentric tubes with smooth or longitudinally finned surfaces is described. The geometry of the fuel element and the density distribution of heat sources in the fuel element are assumed as given and an iterative method of calculation is then used. The length of the element is divided into a certain number of parts and the temperature of the cooling gas, the surface temperature and the maximum temperature in the U-tube are determined for each dividing plane. Descriptions of a program compiled in GIERALGOL language, the input tapes, and print-out results are included. Author (NSA)

N69-23165# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung.
CALCULATIONAL METHOD FOR DESCRIBING THE WEAKENING OF FUEL CANS IN LIQUID METAL COOLED FAST REACTORS [EIN RECHENVERFAHREN ZUR FESTIGKEITSMAESSIGEN AUSLEGUNG DER BRENNSTABHUELLROHRE BEI FLUESSIGMETALLGEKUEHLTEN SCHNELLEN REAKTOREN]
G. Schmidt Jul. 1968 131 p refs In GERMAN
(KFK-808; EUR-3968.D) Avail: AEC Depository Libraries

The bases for theoretical treatment of creep reactions of fuel element cladding material with flowing liquid Na are given. The equations describing the creep effects are developed. Numerical techniques used for solving the equations are described. Stress limits for the cladding tubes are derived; thermal racheting criteria are developed for the general case. The mathematical model for determining the radial swelling rate is given; the flow diagram for computer solution to the equations is given. NSA

N69-23167# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelement.
HIGH-EFFICIENCY HYDRAULICALLY DAMPED SPRING BANK FOR BRAKING AND INTERCEPTING NUCLEAR REACTOR CONTROL RODS [EIN HYDRAULISCH GEDAEMPFTES FEDERPAKET HOHER LEISTUNGS-FAEHIGKEIT ALS BREMS UND ABFANGELEMENT FUER KERNREAKTOR-REGELSTAEBE]
O. Muehlhaeuser
(EURFNR-530; EUR-3720D; KFK-735) Avail: CFSTI

Damped spring components are required at 2 points in the core of a nuclear reactor: in the safety rod in order to brake the rod inserted in the case of scram shutdown; and underneath the fuel bundles in order to intercept any bundles which become detached, so that neither parts of the core nor the bundle itself is destroyed as they fall under gravity. The spring system developed consists of individual saddle-shaped warped discs, which, in the same way as plate springs, are grouped together in a bank and installed in a housing. The damping is effected by forcing out the liquid between the individual discs and the wall of the housing. The elasticity characteristics were determined theoretically and confirmed by measurements on a plexiglass model. The advantage of this type of spring compared with the others, e.g., helical springs, lies in the simple construction of the damping device, its insensitivity to rupture and its much improved efficiency compared with plate springs. Author (NSA)

N69-23173# California Univ., Livermore. Lawrence Radiation Lab. Radiation Lab.
RANKINE CYCLE SYSTEMS STUDIES FOR NUCLEAR SPACE POWER

J. H. Pitts and M. H. L. Jester 31 May 1968 24 p refs
Submitted for publication Supported by AEC
(UCRL-70863; Conf-680802-6) Avail: CFSTI

Two different types of Rankine cycle systems studies are described which can be used to advantage in conjunction with each other. A simple, flexible conceptual design representation gives consistent, general trend results and yet requires minimum expenditure of effort to incorporate changes. After initial design phases are complete, a detailed system representation that includes extensive neutronic and shielding information is used to give final design characteristics of the complete system and components of interest. Some recommendations for future effort are made.
Author (NSA)

N69-23196# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
COMPARISON OF HETEROGENEOUS AND HOMOGENEOUS METHODS USED IN THE CALCULATIONS OF ORGEL REACTORS [COMPARAISON DES METHODES HETEROGENES ET HOMOGENES UTILISEES DANS LE CALCUL DES REACTEURS ORGEL]
A. Decressin and J. Ligou 1968 37 p refs
(Proj. ORGEL)
(EUR-4205.F) Avail: CFSTI

The knowledge of flux distributions in a power reactor is of very great practical interest. Therefore, in the frame of the conceptional design of an Orgel Prototype several calculation methods have been compared, principally Trihet and Equipoise. The differences initially stated between the two methods have led to enlargement of the domain of the studies. In the application of homogeneous and heterogeneous codes general conclusions could be derived from the various examples presented. Author

N69-23201# Brookhaven National Lab., Upton, N. Y.
LOCATION OF HIGHER SPATIAL HARMONIC STABILITY CRITERIA
G. S. Lellouche 28 Oct. 1968 35 p ref
Avail: CFSTI

Reactor linear stability criteria are developed in both one and two group representations. Prompt xenon yield is neglected; the flux distribution is assumed to be in a quasi-static distribution. The equations are developed for the bare reactor; then reflector effects are considered. NSA

N69-23233# Oak Ridge National Lab., Tenn.
GCR-ORR LOOP 1 FUEL ASSEMBLY NO. 14, AN IRRADIATION TEST OF LARGE LOOSE BEDS OF PYROLYTIC-CARBON-COATED SOL-GEL OXIDE PARTICLES
A. W. Longest, J. A. Conlin, D. R. Cuneo, E. L. Long, Jr., and M. F. Osborne Nov. 1968 79 p refs
(Contract W7405-ENG-26)
(ORNL-TM-2278) Avail: CFSTI

An irradiation experiment to study the behavior of relatively large beds of loose coated particles in graphite was conducted. The experimental assembly consisted of two capsules aligned one above the other in the loop. The fuel in both capsules consisted of a mixture of two batches of pyrolytic carbon coated sol–gel oxide particles. One of the batches had ThO_2 cores, and the other $(Th,U)O_2$ cores, the latter with a thorium to uranium ratio of 11.9. The upper capsule was vented to the loop coolant for fission gas release determination and contained, in addition to 57.6 g of fuel particles, BeO pellets in contact with graphite for study of compatibility. Mild oxidation of the graphite parts and pitting of the fuel particle coatings in the upper vented capsule occurred as a result of abnormally high contaminant levels in the loop coolant during irradiation. No evidence of a compatibility problem between BeO and graphite (at ≈ 1300°C) was found, and no significant shrinkage of ATJ graphite that could be attributed to radiation damage was detected. Author (NSA)

N69-23234# Oak Ridge National Lab., Tenn.
COMPUTER PROGRAM FOR HANDLING AND COMPARING FISSION PRODUCT DATA FROM RIBDOR FOR MIXTURES OF REACTOR FUELS IRRADIATED UNDER DIFFERENT CONDITIONS: APPLICATION TO ATOMICS INTERNATIONAL LMFBR FUEL
W. Davis, Jr. and H. F. Soard Nov. 1968 26 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2393) Avail: CFSTI

Summarized are the methods for handling output from the RIBDOR program for calculating grams, gram–atoms, curies, β power, and γ power of fission products as a function of burnup and out of reactor decay time. Two programs, a modified RIBDOR program to punch the desired data, and a program to handle the cards, are required. The data manipulating program provides for combining specified quantities of various types of fuel and comparing the resulting fission product quantities with those for any reference reactor. Detailed tables of data are presented for solutions derived from Atomics International LMFBR fuel for decay times of 30 days to 100 years. A detailed tabular comparison shows that the total amount of radioactivity (curies, β power, γ power) present in such a solution, containing 65.1 g of (U + Pu) at 30 days out of reactor, is very similar to that found in a solution obtained from a conceptual reference reactor fuel containing 300 g of U, at 180 days out of reactor. Author (NSA)

N69-23235# Bettis Atomic Power Lab., Pittsburgh, Pa.
SHORT-TERM IRRADIATION OF ZIRCALOY-4 CLAD FUEL RODS CONTAINING LOW-DENSITY OR ANNULAR ZIRCONIUM DIOXIDE URANIUM DIOXIDE CERAMIC FUEL PELLETS: X-1-t TEST. LWBR-LSBR DEVELOPMENT PROGRAM
H. B. Meieran, W. F. Bourgeois, and J. T. Engel Jun. 1968 202 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-630) Avail: CFSTI

The X-1-t irradiation test was a pilot test in the development of Zircaloy clad bulk oxide fuel elements having high thermal and depletion ratings for the LSBR program. The test was run on fuel rods containing ZrO_2–47 wt % U^EO_2 fuel pellets; the rods contained either 95% TD annular pellets or 84% TD solid pellets. The test was terminated after 7 days when one of the solid, low-density rods failed, due to attack of molten fuel on the clad with resulting clad melting and burnout. There was severe internal hydriding of the failed clad, and all rods showed internal ZrO_2-type corrosion products, attributed to O_2 pickup by Zircaloy at high temperatures. The solid, low density rods showed gross fuel redistribution and fuel pellet melting. The annular pellets did not melt, but did show some fuel redistribution. Structural changes are estimated at 90% in the solid fuel and 15% in the annular fuel. The solid rods showed a post irradiation ovality of cladding, with small depressions (dimples) on the minor axis of the oval. Author (NSA)

N69-23246# Ceskoslovenska Akademie Ved, Rez.
CALCULATION OF THE CORRECTION FACTOR RESPECTING BURNUP OF 60 CO AND 59 CO IN COBALT DETECTORS
S. B. Rana Jun. 1968 7 p refs
(UJV-2034) Avail: AEC Depository Libraries

Values of the coefficient, f, which enables correction of the average Westcott flux due to burnup of ^{59}Co and ^{60}

during long term measurements with a Co activation integrator, are tabulated. The correction coefficient f changes from negligible amounts at fluxes of the order 10^{12} n/cm^2/sec and irradiation time of the order of a few days to considerable amounts at fluxes of the order 10^{15} n/cm^2/sec. Author (NSA)

N69-23247# Bettis Atomic Power Lab., Pittsburgh, Pa.
ANALYSIS OF VOID MIGRATION, CLAD COLLAPSE AND FUEL CRACKING IN BULK OXIDE FUEL RODS (LWBR DEVELOPMENT PROGRAM
E. Duncombe Jul. 1968 38 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-794) Avail: CFSTI

Methods of accounting for void migration, fuel cracking, fuel-clad friction and clad collapse in the analysis of the performance of bulk oxide fuel rods are presented. The required modifications to the Cygro-2 computer program are specified. The observed coring radius of a fuel rod containing ThO_2 5.6w/o UO_2 is in agreement with the model if suitable allowance is made for fission-induced swelling. In-pile length changes of a non-free-standing test fuel rod containing ThO_2 20 w/o UO_2 are also explained on the basis of the fuel cracking model. Author (NSA)

N69-23253# Commissariat a l'Energie Atomique, Saclay (France).
MULTIGROUP CALCULATION OF THE FAST FISSION FACTOR IN A THERMAL REACTOR LATTICE
Dusan B. Stefanovic (Ph.D. Thesis--Paris Univ.) Sep. 1968 58 p refs In FRENCH
(CEA-R-3549) Avail: AEC Depository Libraries

To improve the fast fission factor calculation in graphite and heavy water lattices, a multigroup method with a matricial formulation was chosen. Assumptions can thus be avoided. Backscattering and interaction effects were calculated by combining Monte-Carlo and multigroup methods. From a set of Monte-Carlo calculated probabilities, the multigroup spectrum of neutrons entering a rod were defined from the spectrum of the neutrons leaving the rod. A new definition of the fission factor, which takes into account back-scattering and interaction in a reactor lattice, was obtained. Results are compared to recent experimental data. Author (NSA)

N69-23263# Westinghouse Electric Co., Pittsburgh, Pa. Atomic Power Div.
POST-IRRADIATION EXAMINATION OF CVTR FUEL ASSEMBLIES Semiannual Progress Report, Period Ending 30 Jun. 1968
M. G. Balfour, ed. Aug. 1968 131 p
(Contract AT(30-17-3850)
(WCAP-3850-3) Avail: CFSTI

Nondestructive examinations were made of assemblies of modified CVTR; radiation effects on Zircaloy 4 cladding for CVTR rod-type were also made. Tabular summary of characteristics of CVTR, results of metallographic analysis, results of profilometer test, and fission gas analysis were presented. Burst tests and room-temperature induced corrosion were performed on the cladding. Data was tabulated on its welding and mechanical properties. Similar tests were performed on Carolinas-Virginia tube reactor. NSA

N69-23268# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NUCLEAR SAFETY; FOR NUCLEAR SAFETY BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Report, Nov. 1967-Jan. 1968
Sep. 1968 152 p refs
(Contract AT (45-1)-1830)
(BNWL-816) Avail: CFSTI

Abstracted data are presented on various aspects of the reactor development and technology research. Subjects discussed include engineering safeguards, pressure bearing component monitoring and evaluation, fixation of radioactive residues, environmental studies, and the heavy section steel technology program. S.G.D.

N69-23270# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
INSULATION OF THE FFTF CLOSED LOOP TUBES
G. R. Sawtelle Nov. 1968 37 p refs
(Contract AT(45-1)-1830)
(BNWL-755) Avail: CFSTI

The FFTF closed loop tubes will operate in liquid Na at a temperature level of up to 1400°F with a wall temperature difference of 400°F. Methods of providing insulation to reduce heat transfer and thermal stresses to acceptable levels are evaluated. A twin-wall tube was chosen to provide an annular gap, isolated from the sodium, for the insulating materials, and to provide a gas circulation channel for controlling the thermal conductivity of the tube wall. Author (NSA)

N69-23274# Gulf General Atomic, San Diego, Calif.
RETENTION OF IODINE BY PYROLYTIC CARBON COATED NUCLEAR FUEL PARTICLES
S. Langer, C. C. Adams, E. E. Anderson, J. N. Graves, and T. Yamaguchi 6 Mar. 1968 9 p refs
(Contract AT(04-3)-633)
(GA-8524; Conf-680306-13) Avail: CFSTI

The retention of fission-product iodine by pyrolytic-carbon-coated $(Th,U)C_2$ fuel particles has been studied in annealing experiments at 1100° and 1300°C. The objective was to measure the low release rates from the particles and to obtain a material balance between the measured release and the inventory in the particles. The study was carried out on control (lightly irradiated to $\approx 10^{13}$ fissions) particles and on highly irradiated particles. The specimens (20 to 5000 fuel particles) were activated to produce short-lived Xe and I, and the releases were studied in annealing experiments at 1100° and 1300°C for 15 hours. The fission gases released were collected in liquid-nitrogen-cooled charcoal traps, which were gamma counted to determine the amounts released. For the unirradiated particles, the release of ^{135}Xe was $< 10^{-5}$ and ^{133}I was $< 10^{-4}$ Author (NSA)

N69-23289# Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Reaktorzentrum.
DETERMINATION OF DISTRIBUTION AND DEPTH OF PENETRATION OF FISSION FRAGMENTS IN METALS [BESTIMMUNG DER VERTEILUNG UND EINDRINGTIEFEN VON SPALTFRAGMENTEN IN METALLEN]
E. Tutschek and P. Koss 1968 15 p refs In GERMAN
Presented at the Herbsttagung Der Oesterr. Physik. Ges., Graz, 1968 Submitted for publication
(SGAE-M-23/1968) Avail: CFSTI

A method is described for measuring distribution and depth of penetration of the fragments by stepwise removal of layers by means of electrolytic etching. Using this method, maximum depths from 6 to 8μ were measured for the penetration of Xe 133 in silver. The concentration of fission nuclei decreases essentially linearly with depth, a finding in agreement with theoretical deductions. The method also presents a possibility for determining the diffusion coefficients for various temperatures in case the original concentration profile was altered by annealing at these temperatures. A computer program was used to evaluate the measurements. Repeated

measurements following annealing at different temperatures yielded data on the activation energy of the diffusion process. The Xe 133 diffusion coefficients in silver are presented for 700° and 800° C.
Transl. by K.W.

N69-23291# Atomic Power Development Associates, Inc., Detroit, Mich.
ANALYSIS OF SODIUM REACTIVITY MEASUREMENTS. VOLUME 1: CROSS SECTION EVALUATION AND DATA TESTING
T. A. Pitterle, E. M. Page, and M. Yamamoto Jun 1968 104 p refs
(Contract AT(11-1)-865)
(APDA-216-Vol-1) Avail: CFSTI

An analysis of sodium reactivity measurements in fast reactor critical assemblies is presented. Volume II presents the sodium-void analysis. In Vol. I, emphasis is placed on cross section evaluation and data testing conducted to establish the accuracy of the cross section data used for the calculations of Vol. II. Volume I describes the evaluation of the cross section data, testing of the data by comparison of calculations with integral experiment measurements, and an examination of methods used for critical assembly calculations. Neutron cross sections important for the sodium analysis have been evaluated as modifications to ENDF/B data file. Calculations of criticality, reaction-rate ratios, and material worths using both the ENDF/B and modified ENDF/B data have been made for ZPR-III Assemblies 48, 48B, 49, and ZPR-VI Assemblies 2 and 3. The modified ENDF/B data are found to be over-reactive for these assemblies by 0.2% to 0.4% Δk while the ENDF/B data are under-reactive by 1.3% and 0.7% for the ^{239}Pu and ^{235}U-fueled assemblies, respectively. In general, the modified data yield better agreement with experiment than the ENDF/B data.
Author (NSA)

N69-23292# Atomic Power Development Associates, Inc., Detroit, Mich.
ANALYSIS OF SODIUM REACTIVITY MEASUREMENTS. VOLUME 2: SODIUM VOID CALCULATIONS
T. A. Pitterle, E. M. Page, and M. Yamamoto Jun. 1968 104 p refs
(Contract AT(11-1)-865)
(APDA-216-Vol-2) Avail: CFSTI

The second of a two-volume report on an analysis of sodium reactivity measurements in fast reactor critical assemblies is presented. Volume I describes the cross section evaluation and data testing conducted in support of the sodium void analyses. Volume II describes the methods of calculation and the calculated results for an analysis of sodium void measurements performed in ZPR-III Assemblies 48 and 48B and ZPR-VI Assemblies 2 and 3. The detailed void measurements in the assemblies have been calculated using the MENDF/B cross section data described in Volume I, and additional calculations have been with the ENDF/B data. The basic method of calculation is perturbation theory in one- and two-dimensional diffusion theory. Methods examined include variations in resonance self-shielding techniques, number of groups, variations of perturbation theory including exact perturbation theory, transport theory, and heterogeneity considerations. For the heterogeneity analysis, cell-homogenized cross sections are obtained by flux-weighting over the cell using transport theory calculations of the spatial flux distributions. Overall calculations of the void reactivities with the MENDF/B data show better agreement with experiment, particularly for the ^{239}Pu-fueled assemblies.
Author (NSA)

N69-23294# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
TESTING THE HOMOGENEITY OF LAMINATED PLATES BY PHOTOMETRY [CONTROLE DE L'HOMOGENEITE DES PLAQUES COLAMINEES PAR PHOTOMETRIE]
Marie Therese Destribats, Claude Pillet, and Michel Leblanc (Soc. Leanord, Lille (France)) 13 Feb. 1968 27 p refs In FRENCH Presented at the Symp. on Nondestructive Testing and Control in the Field of Nucl. Met. and Technol., Saclay, France, 24 Jun. 1968
(CEA-Conf-1079; Conf-680606-11) Avail: AEC Depository Libraries

The apparatus for the automatic inspection of U distribution in laminated plates by photometry of the radiograph is described. The problem of opacity is overcome by radiographing either side of the fuel plate and the entire length, two standards corresponding to the minimum and maximum contents of the tolerance respectively. The opacity of each point on the radiograph is then compared with the opacity of the standards, at points located in the same transverse plane. Advantages of this method and its accuracy are described.
Author (NSA)

N69-23298# Oak Ridge National Lab., Tenn.
COMPARISON OF OBSERVED AND PREDICTED IRRADIATION PERFORMANCE OF PYROLYTIC-CARBON-COATED URANIUM DIOXIDE PARTICLES
P. E. Reagan, D. M. Hewette, III and J. G. Morgan Dec. 1968 20 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-2336) Avail: CFSTI

A mathematical model developed to predict coated particle failure of coated particles during irradiation was tested. A test capsule containing uranium oxide particles with pyrolytic carbon coatings of 55 to 163 microns thickness was irradiated at 1250°C. The coatings were predicted to fail at 9% burnup, but only 7% burnup was attained because auxiliary particles, used to heat the capsule, began to fail. In a second test, the mathematical model predicted coating failure at 7.8% burnup at 1400°C, and these particles began to fail at 7.5% burnup.
Author (NSA)

N69-23309# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
PRESSURIZED WATER REACTOR pH-REACTIVITY EFFECT Quarterly Progress Report, 1 Jan.–31 Mar. 1968
Apr. 1968 114 p refs
(Contract AT(30-1)-3696)
(WCAP-3696-7; EURAEC-2006) Avail: CFSTI

Continued instrumentation, installation, testing, and data anaylsis are reported. Dynamic measurements, and thermal and hydraulic studies are discussed. Water chemistry data are graphed for boron and lithium concentrations, crud and electrical conductivity, and beta, gamma activity and dissolved hydrogen for various test tests. Reactivity effects and thermocouple data are also graphed.
N.E.N.

N69-23314# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
SAXTON PLUTONIUM PROGRAM Semiannual Progress Report, 1 Jan.–30 Jun. 1968
Aug. 1968 28 p refs
(Contract AT(30-1)-3385)
(WCAP-3385-16; EURAEC-2043) Avail: CFSTI

Comparison of experimental and calculated performance values for plutonium power distributions, of calculated and measured values, and of fuel elements were made for the Saxton power reactor. Burnup distribution in Saxton plutonium was calculated. The reactivity worth of boron poisoning in plutonium fuel elements was determined.
N69-

N69-23323# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
DEVELOPMENT OF STATE 1 BERYLLIA, FUELLED BERYLLIA, AND SPHERICAL BERYLLIA-BASED FUEL ELEMENTS FOR THE HIGH-TEMPERATURE GAS-COOLED REACTOR FEASIBILITY STUDY
K. D. Reeve and E. J. Ramm Sep. 1968 43 p refs
(AAEC/E-193) Avail: AEC Depository Libraries

Requirements of BeO for use as moderator, fuel matrix, and fission product retentive coating in an all-ceramic, dispersion type fuel element for use in a high temperature gas cooled reactor are discussed. Reasons for choosing Brush UOX BeO powder, and isostatic pressing for fabricating it, are given. The characteristics of this powder, and the effects of many fabrication variables on the properties of the sintered product, are discussed in detail. A process was chosen for producing an interim standard sintered BeO, to be known as Stage 1 BeO. The properties of Stage 1 BeO are presented, and suggestions are made for improvement of both the material and the fabrication process. Some discussion is included on the extension of this work to the fabrication of fueled BeO and of BeO-based spherical fuel elements. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-22024 Colorado Univ., Boulder.
LIGHT SCATTERING FROM TIME-DEPENDENT MOLECULAR ORIENTATIONS IN LIQUIDS
Michael McClintock (Ph.D. Thesis) 1967 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-10620

A 50 milliwatt argon ion laser was used as a source of 4880Å radiation to excite the scattered light spectrum of several liquids and liquid mixtures. Analysis was made of the broad, depolarized spectral line that underlies the Rayleigh-Brillouin triplet in benzene, carbon disulfide, and carbon tetrachloride. This spectral line is attributed to time-dependent molecular reorientations (orientation scattering), and rotational relaxation times were therefore obtained for the condensed phase on the assumption that the reorientation of molecules is adequately described by a model involving rotational Brownian motion. A theory was developed to relate the rotational diffusion constant for anisotropic molecules to the concentration of mixtures composed of unassociated liquids. Dissert. Abstr.

N69-22035 Pennsylvania State Univ., University Park.
THE TEMPERATURE DEPENDENCE OF ACOUSTICAL PROPAGATION IN LIQUIDS IN THE GIGAHERTZIAN REGION
John Randall Kenemuth (Ph.D. Thesis) 1967 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-11993

The spontaneous Brillouin effect was used to investigate the temperature dependence of acoustical propagation in nine liquids in the gigahertzian region. A 240 mw He–Ne laser was used as the light source. Photoelectric detection of the intensity of light transmitted by a pressure scanned, high reflectivity, Fabry-Perot interferometer was employed. Sound speeds were measured in dibromomethane, dichloromethane, chloroform, water, and pentachlorobiphenyl for temperatures within the range from −23°C to 138°C using an angle of scattering of 90°. Similar measurements in carbon tetrachloride, nitrobenzene, and benzene previously made were analyzed. Sound speeds at room temperature were also measured at 25° and/or 155° scattering angles for dibromomethane, dichloromethane, chloroform, carbon tetrachloride, and benzene in order to separate the temperature effect from the frequency effect. This permitted a determination of the temperature coefficient of the hypersonic speed as well as the dispersion of the sound speed for these liquids. The amplitude absorption coefficient for hypersonic waves in glycerol was measured over the temperature interval from −12°C to 134°C. Dissert. Abstr.

N69-22048 Colorado State Univ., Fort Collins.
TRANSIENT FLOW OF CRYOGENIC FLUIDS
Willis Gene Steward (Ph.D. Thesis) 1968 237 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-14951

An analytical program has been developed and tested by experiments with liquid nitrogen and liquid hydrogen in vacuum-insulated pipelines. The program, within the limits of the testing experiments, successfully predicts the general behavior of such systems. For a given geometry and a given set of fluid and equipment starting conditions, the solution produces pressure, temperature, quality (mass fraction of vapor), density, velocity and location of arrays of fluid segments distributed throughout a pipeline. One such array and computation of a new wall temperature distribution is produced at each of a series of time increments. A simplified cooldown time prediction method is included. Recommendations are made for changes and operating procedures to minimize the probability of the very large pressure surges which can occur immediately following valve opening. Dissert. Abstr.

N69-22067 Syracuse Univ., N. Y.
WAVEGUIDES OF ARBITRARY CROSS SECTION BY MOMENT METHODS
Thomas Whitmore Bristol (Ph.D. Thesis) 1968 170 p
Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-13818

The general method of moments formulation for the approximate solution of linear differential eigenvalue problems is presented. Galerkin's method is a special case of the general method. Various Galerkin solutions of the one-dimensional Laplacian eigenvalue equation are given, and the results are used as a guide for solutions of the two-dimensional Helmholtz equation. A new solution for the approximate cutoff wavenumbers, wavefunctions, and fields of the lower order modes of waveguides of arbitrary cross section is given. The Helmholtz equation is reduced to a trio of first-order differential equations, and the domain of the resulting operator is extended to include expansion functions which do not satisfy the waveguide boundary conditions. Approximate solutions are given for rectangular, ridge, and circular waveguides. The solutions converge much more rapidly than do the corresponding finite-difference approximate solutions. Dissert. Abstr.

N69-22068 Illinois Univ., Chicago.
GENERAL FORMULATION OF STABILITY CRITERIA FOR NONCONSERVATIVE ELASTIC OR INELASTIC SYSTEMS
Rong Chung Shieh (Ph.D. Thesis) 1968 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-12194

This thesis contains a formulation of general stability criteria, based on dynamic (Liapunov) concepts of stability and within the framework of infinitesimal stability theory, for an autonomous inelastic or elastic solid which is in equilibrium under conservative or nonconservative external forces. The equilibrium position itself may be based on finite deformations, the external forces may consist of both velocity dependent forces (damping or gyroscopic) and of displacement forces (conservative or nonconservative). From these criteria, work theorems for stability under forced motions and

approximate methods for finding critical loads are deduced, and the range of validity of classical stability criteria is discussed. Examples are given for demonstration purposes. Dissert. Abstr.

N69-22072 Delaware Univ., Newark.
INSTANTANEOUS ACTION-AT-A-DISTANCE FORMULATION OF CLASSICAL ELECTRODYNAMICS
Frederick James Kennedy, Jr. (Ph.D. Thesis) 1967 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-13159

The action-at-a-distance formulation of classical electrodynamics is achieved by taking the conventional force on a charge expressed in terms of the Euler–Lagrange derivative on the velocity dependent potential (which is expressed in terms of past time because the potentials are the Lienard-Wiechert potentials), and by expansion about some oberver's present time, writing these forces as functions of particle behavior at a single instant. On the basis of the Wheeler-Feynman scheme of employing half advanced and half retarded interactions, an action principle is constructed, and the constants of the motion are found via the Noether theorem. Dissert. Abstr.

N69-22162 Stanford Univ., Calif.
ON A RESTRICTED PROBLEM ON TWO RIGID BODIES
David Bascomb Johnson (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-11312

The problem of obtaining descriptions of the motions of systems of two free rigid bodies is solved along with the corresponding restricted problem. The particular restricted problem considered is characterized by four assumptions and using Hamilton-Jacobi theory and the method of averaging, an explicit, analytical description of the motions of two rigid bodies is found, and an application of this result to close binary systems is presented. Dissert. Abstr.

N69-22194*# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.
SPECTROGRAPHIC STUDIES OF LUMINESCENCE IN CHARGED-PARTICLE-IRRADIATED OPTICAL MATERIALS
Final Report
John Romanko, R. H. McDaniel, J. K. Miles, P. R. Cheever, and G. S. Massingill 21 Mar. 1969 152 p refs
(Contract NAS1-7734)
(NASA-CR-66758; FZK-364) Avail: CFSTI CSCL 20F

The spectral luminescence induced in optical glasses and quartzes by high-energy charged particles was measured in the wavelength range from 300–650 nanometers (nm) utilizing a grating spectrograph of 0.5 nm resolution. Electron energies were 1, 2, 3, 5, 10 and 20 MeV; proton energies were 1, 2, and 3 MeV. Fluxes were from 2.5×10^{11} to 5×10^{13} particles/cm^2-sec. The induced luminescence varied from a few tenths to 100 nanowatts/cm^2-steradian-nm in the visible region. Only the luminescence of the quartzes was linear with flux and absorbed dose of 1, 2, and 3 MeV electrons. Author

N69-22205# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROSPECTS OF APPLICATION SUPERCONDUCTORS IN ELECTRICAL MACHINES AND THE PROBLEM OF BOOSTING SUPERCONDUCTING SYSTEMS
E. Ya. Kazovskii Aug. 1968 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSR, Energ. Transp. (Moscow), no. 4, 1968 p 12–25
(AD-681601; FTD-MT-24-212-68) Avail: CFSTI CSCL 20/3

The report describes recent developments and future prospects in superconductor technology. Topics include: refrigerators; cost factors; heat flux through thermal insulation and conductors; booster transformers and generators, including various topological generators; degradation effect; AC losses; voltage ratings and power limiting factors. TAB

N69-23245# Uppsala Univ. (Sweden). Inst. of Physics.
THE SPECTRUM OF O V
Kjell Bockasten and Bertil Johansson Mar. 1968 51 p refs
(UUIP-574) Avail: AEC Depository Libraries

The spectrum of four times ionized oxygen, O V, was studied with a theta-pinch discharge as a light source. Measured were 126 lines on the wavelength region 340 to 7700 Å, 93 of them being new lines. From these new measurements and 31 additional lines in the region 172 to 287 Å, measured earlier, the whole energy-level system was recalculated. The singlet and triplet systems were connected by common hydrogen-like transitions and by three intercombination lines. The uncertainty between the triplet and singlet levels in O V as earlier reported was $x = -182.4$. The ionization limit was determined to 918 657 ± 4 K by applying the polarization formula to the hydrogen-like levels and by using the theoretically predicted value of the dipole polarizability. Calculated wavelengths are given for 66 lines in the region 124 to 286 Å, suitable as reference lines. Author (NSA)

N69-22254# RAND Corp., Santa Monica, Calif.
APERTURE AVERAGING FACTOR OF A FLUCTUATING LIGHT SIGNAL
R. F. Lutomirski and H. T. Yura Jan. 1969 9 p refs
(AD-681493; P-4008) Avail: CFSTI CSCL 20/6

The aperture averaging factor, which gives the effect of a finite diameter receiving aperture in reducing the variance of a fluctuating light signal is studied. Author (TAB)

N69-22350# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
PROPERTIES OF LIQUID HELIUM THREE AND SOLUTIONS OF He 3 IN He 4 [PROPRIETES DE L'HELIUM 3 LIQUIDE, SES SOLUTIONS DANS L'HELIUM 4]
Jean-Paul Breton (Ph. D. Thesis) Oct. 1968 22 p refs in FRENCH; ENGLISH summary
(CEA-BIB-132) Avail: CFSTI

Since the first liquefaction of helium 3 a great deal of theoretical and experimental work has been done to study its properties. First some of these properties are derived, with the help of very simple theoretical considerations. Then the experimental work on the properties of pure He 3 are reviewed (equilibrium P-T diagram, density, specific heat, magnetic susceptibility, viscosity, thermal conductivity, zero sound). The last chapters deal with the problem of superfluidity, and of solutions of He 3 in He 4 (isotopic phase separation, λ-transition for the mixture).

N69-22424# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
AUTOMATIC MAGNETIC SUSCEPTIBILITY MEASUREMENTS BETWEEN 4° K AND 1200° K [MESURE AUTOMATIQUE DES SUSCEPTIBILITES MAGNETIQUES DE 4° K A 1200° K]
Georges Raphael Jan. 1969 36 p refs In FRENCH; ENGLISH summary
(CEA-R-3722) Avail: CFSTI

A detailed description is given of a Faraday magnetic susceptibility balance which operates from 4°K to 1200°K, and

some preliminary results on platinum and titanium illustrate the precision and the sensitivity of the measurements. The apparatus has been designed for measurements on plutonium compounds which constitute severe health hazards. Author (ESRO)

N69-22425# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
A REPORT ON THE 1967 APPLIED SUPERCONDUCTIVITY CONFERENCE
B. W. Birmingham, B. B. Goodman, W. H. Hartwig, R. A. Kamper, and J. E. Kunzler Jun. 1968 4 p Submitted for publication
(PB-180899; R-472) Avail: CFSTI CSCL 20C

Highlights from the papers and panel discussions presented at the symposium are given. USGRDR

N69-22541# RAND Corp., Santa Monica, Calif.
FAR-FIELD INTENSITY DISTRIBUTION FROM A DIFFRACTING APERTURE IN A TURBULENT MEDIUM
H. T. Yura Dec. 1968 34 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-682209; RM-5710-ARPA) Avail: CFSTI CSCL 20/5

Given is an analysis of the effect of atmospheric turbulence in the Fraunhofer region on a near-horizontal beam of finite cross-section near the earths surface. The far-field intensity distribution at optical frequencies of an initially plane wave from a finite, circular, source aperture is obtained as a function of range and angle for various values of the index structure constant. Describing the turbulence-induced index of refraction fluctuations by the Kolmogorov spectrum, it is found that the time average of the peak radiant intensity in the Fraunhofer region of a finite source aperture decreases with range at a much faster rate than the intensity calculated from absorption and scattering by molecules and particulate matter. Specifically, a beam from a 2-cm aperture at a wavelength of 0.6328 microns in moderate daytime turbulence will have an unscattered range of 5 km. For small values of the inner turbulence scale, the effects of turbulence are dominant over most of the ranges of interest. Author (TAB)

N69-22545*# Kaman Nuclear, Colorado Springs, Colo.
VARIABILITY OF SOUND PROPAGATION PREDICTION DUE TO ATMOSPHERIC VARIABILITY
C. Eugene Buell Washington NASA Apr. 1969 85 p refs
(Contract NASS-11348)
(NASA-CR-1338; KN-68-698-4) Avail: CFSTI CSCL 20A

It covers topics related to estimating sound intensity from a stationary source in the natural atmosphere; it also covers some of the problems of estimating sound intensity from a moving sound source. In both cases the far field of sound propagation is of primary interest (1. to 40. km). The major results in the first part deal with the estimation of intensity by calculating a single ray and associated parameters and the method of locating caustics above the ground. To estimate sound intensity at a point the rate of change of distance to the returning ray with respect to initial inclination angle is required. This may be obtained numerically from the distance of the returning ray when they were calculated for several rays. It seems desirable to differentiate the integrals for distance with respect to inclination formally and compute these derivatives as part of the ray tracing procedure. Author

N69-22769*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ABSORPTION OF INFRARED RADIATION BY ICE CRYODEPOSITS
Stephen V. Pepper Washington Apr. 1969 22 p refs
(NASA-TN-D-5181) Avail: CFSTI CSCL 20M

The absorption of isotropic 300 K black-body radiation by ice cryodeposits is analyzed theoretically. The analysis is based on the hypothesis that the cryodeposit reflects infrared radiation specularly. The effects of interfering and noninterfering multiply reflected waves are investigated. The main results of the analysis are predictions of the absorptance as a function of cryodeposit thickness. The effect of interference is to lower the cryodeposit absorptance for thicknesses less than 2 micrometers. Reasonably good agreement with available experimental data has been achieved over a wide range of thicknesses. Author

N69-22788# Frankel (Sidney) and Associates, Menlo Park, Calif.
SAMPLING THEORMS AND THE SMOOTHING OF LOW-RESOLUTION, QUANTIZED, ACOUSTIC IMAGE DATA
Albuquerque, N. Mex. Sandia Aug. 1968 39 p refs Supported by AEC Prepared for Sandia Corp.
(PB-180876; SC-CR-68-3661) Avail: CFSTI CSCL 20A

The report shows how a two dimensional quantized acoustic image may be smoothed in a simple manner, without further loss of information, by an implementation related to sampling theorem concepts. Author (USGRDR)

N69-22917# Massachusetts Inst. of Tech., Cambridge. Microwave and Quantum Magnetics Group.
MICROWAVE MAGNON-PHONON INTERACTIONS IN FERROMAGNETS AND ANTIFERROMAGNETS Final Report, 1 Mar. 1966–30 Jun. 1968
Frederic R. Morgenthaler Jul. 1968 125 p refs
(Contract AF 19(628)-5876)
(AD-681848; AFCRL-68-0404) Avail: CFSTI CSCL 20/3

The research performed under the contract is summarized. The current state of the research on parametrically-pumped magnon instabilities, antiferromagnetic resonance in RbMnF3 and small signal conservation theorems for magnetoelastic ferromagnets is discussed. Author (TAB)

N69-23093# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Laboratori Gas Ionizzati, Frascati.
ON THE GENERATION OF HIGH MAGNETIC FIELDS (MEGAGAUSS) BY CYLINDRICAL IMPLOSION [SUR L'OBTENTION DE CHAMPS MAGNETIQUES INTENSES (MEGAGAUSS) AU MOYEN D'UNE IMPLOSION CYLINDRIQUE]
J.-P. Somon EURATOM 1968 88 p refs In FRENCH; ENGLISH summary Sponsored in part by EURATOM
(EUR-4197.F) Avail: CFSTI

This work is a theoretical study of the high magnetic fields generation obtained by the explosive-driven cylindrical implosion of a hollow conducting cylinder against a trapped axial field. Several mechanisms are limiting the efficiency of the process and are successively considered: energy losses due to the conductor compressibility, magnetic flux losses by field diffusion, conductor destruction by Rayleigh–Taylor instability of the motion or by vaporization due to Joule heating. These phenomena are studied and criteria for maximum fields are derived. It may be concluded that the implosive generation of fields around 20 megagauss seems to be possible; it should be extremely difficult to achieve greater fields. The main experiments are described and their results compared to the theory. Author

N69-23103# Brigham Young Univ., Provo, Utah. Dept. of Physics.
EVOLUTION OF PETROV TYPES OF SPACES IN GENERAL RELATIVITY
Lloyd A. Case (Ph.D. Thesis) May 1968 90 p refs
(Grant NSF GP-4902)
Avail: Issuing Activity

A theoretical study is made of the evolution of a space-time of one Petrov type into another. The word evolution is used to mean that change of type which a point observer would consider his local space-time had experienced as a discontinuous front swept over him. The study is motivated by a desire to better understand the Petrov classification and thus improve its use as a tool to deal with solutions in general relativity. An algorithm is developed that may in principle be used to test the evolution of any closed-form solution known. A flow diagram is found which shows the routes that each Petrov type may use and the Petrov type of the discontinuity causing each change. During this development some results of the study of discontinuous hypersurfaces are found essentially equivalent to Trautman's information approach to waves, thus yielding further motivation for the use of the latter. The Weyl technique is understood as an important method for at least partially separating the coordinate and physical behaviors.
Author

N69-23149# California Univ., Berkeley. Lawrence Radiation Lab.
CRYOGENIC ELECTRICAL LEADS
Carl D. Henning 12 Jul. 1968 13 p Submitted for publication
(Contract W-7405-eng-48)
(UCRL-71150; CONF-680621-3) Avail: CFSTI

Electrical leads entering a cryostat cause an influx of heat, resulting in evaporation of the cryogen. For liquid helium applications especially, it is important to minimize this heat influx, and several studies have resulted during the past decade. Here, all the available experimental data are reviewed to support a simplified design procedure for optimum gas-cooled leads. The present and predicted efficiency of electrical leads is discussed, and recommendations are made for future research.
Author (NSA)

N69-23199*# Kaman Sciences Corp., Colorado Springs, Colo.
THE EFFECTS OF ATMOSPHERIC FLUCTUATIONS AND REPRESENTATION UPON PROPAGATED SOUND
R. C. Bundgaard Washington NASA Apr. 1969 108 p refs
(Contract NAS8-11348)
(NASA-CR-1337; KN-67-698-2) Avail: CFSTI CSCL 20A

The diagnosed strength of noise fields was obtained by the conventional ray tracing method. When this method is applied to the general problem of estimating expected variations in sound intensity level, the procedure suffers from two disadvantages: the procedure does not always give an estimate; in several instances, its application may be physically unsound. Whenever the ray method does give an estimate, however, it was found that the estimated field strength depends upon the observed atmosphere and the way in which the observed atmosphere is to be represented. The Monte Carlo method is used for estimating short period fluctuations in the noise fields, by means of an artificial experiment for sampling small scale changes in the atmosphere. A nonlinear technique is introduced for representing the aerological observations. The two methods are compared as well as the results obtained by them. It is concluded that the linear method introduces big errors into the diagnosed strength of noise fields. It is recommended that nonlinear methods be used instead of the straight stepped representation of aerological parameters.
Author

N69-23209# Lockheed Missiles and Space Co., Palo Alto, Calif.
POLARIZATION LIGHT MODULATOR
I. I. Adrianova et al 6 Jan. 1968 3 p refs Transl into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 10, 1968 p 40-42
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A description is given of the DP-663 polarization light modulator for monochromatic radiation, and its fundamental characteristics are presented for the modulation of a He-Ne laser with $\lambda = 632.8$ nm. The modulator disclosed a presence of resonance at a frequency on the order of tens of kilohertz; no resonances in the amplitude frequency characteristics were detected at higher frequencies than approximately 10^8 Hz.
Author

N69-23223# Stanford Linear Accelerator Center, Calif.
STUDY OF ELECTRON-INDUCED DESORPTION FROM THE SURFACE OF METALS
Yu. P. Vakhrushin and V. V. Ryabov Jun. 1968 11 p Transl. into ENGLISH from Russian Preprint
(SLAC-Trans-86) Avail: CFSTI

The electrodesorption of gases from the surface of Ti and Ni is studied. Vacuum properties of Ni and Ti at 10^{-8} to 10^{-7} torr are presented. A comparison of gas electrodesorption from stainless steel, Ti, and Ni is also presented.
NSA

N69-23227# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
THE MOTION OF PARTICLES IN HELICAL FIELDS HAVING EQUIPOTENTIALS COINCIDING WITH THE MAGNETIC SURFACES
A. P. Popryadukhin [1968] 18 p refs Transl. into ENGLISH of USSR Acad. of Sci., Inst. of Phys. Preprint No. 51
(AEC-tr-7008) Avail: CFSTI

Electrical field effects on the motion of particles in a system of helical symmetry were studied. The data show that even small electric fields exert an effect which results in strong redistribution of particle velocities according to various types of motion. Detailed studies of particle motions in complex configurations of electric fields are reported.
NSA

N69-23290# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
METHODS OF ELECTRONIC CONTROL FOR PHYSICS EXPERIMENTS [METHODEN DER ELEKTRONISCHEN STEUERUNG PHYSIKALISCHER EXPERIMENTE]
W. Attwenger and R. Patzelt Oct. 1968 23 p In GERMAN Submitted for publication
(SGAE-E-12/1968) Avail: CFSTI

The improved and extended application of data processing equipment in physics experiments is reviewed in the light of the fast development of electronic logic units. Such concepts as on-line application, real time operations, time sharing, time slicing, and program "swapping" are examined for application possibilities. Programmed control as well as experiment-controlled transmission between the data processing equipment and the experiment are considered. Instrumentation requirements for data processing systems are discussed, and a system is described which meets the requirements.
Transl. by K.W.

N69-23293# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON PASSIVE STABILIZATION OF STATIONARY MOTION OF A SOLID BY USING A FLYWHEEL
V. V. Krementulo [1968] 7 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tvardogo Tela (Moscow), no. 6, 1968 p 22-27
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The problem of stabilizing the permanent rotation of a weightless solid, moving by inertia, by using a damping flywheel is examined. The differential equations of motion of the given mechanical system with four degrees of freedom (the body and the flywheel) are formed, and the asymptotic stability of stationary motion, corresponding to uniform rotation of the whole system as a single whole around one of its principle axes of inertia, is established.
Author

N69-23331*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON ASYMPTOTIC STABILITY ACCORDING TO LIAPUNOV IN SOME CRITICAL CASES
V. V. Kostin. Redstone Arsenal Ala. Redstone Sci. Inform. Center Jan. 1969 6 p refs Transl. into ENGLISH from Dupovidi Akad. Nauk. UK. RSR (Kiev), v. 35, no. 1, 1967 p 21-25 Sponsored in part by Army
(NASA-CR-100602; RSIC-892) Avail: CFSTI CSCL 12A

Three systems of differential equations are investigated. Some or all real parts of the eigenvalues of A(t) approach zero as $t \to +\infty$. Sufficient conditions are obtained for asymptotic stability according to Lyapunov of the solutions of the systems at $t \to +\infty$. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-21958 Nebraska Univ., Lincoln.
AUTOIONIZING LEVELS OF NEON PRODUCED BY H^+, He^+, AND Ne^+ BEAMS
Alan Kent Edwards (Ph.D. Thesis) 1968 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-11551

The autoionizing levels of neon were produced by bombarding neon with H^+, He^+, and Ne^+ beams in the energy range 100-300 keV. The electrons ejected by neon were observed at 160° from the beam direction. A parallel plate analyzer was used to energy analyze the electrons before allowing them to strike the first dynode of a 14 dynode electron multiplier. An X-Y recorder was used to make a plot of relative count rate versus electron energy. The count rate was divided by the beam current to eliminate any effects due to a changing beam intensity. The most intense transitions observed were due to inner shell excitations of Ne 1 and Ne 2. Some two electron excitations were also observed. The He^+ beam was found to produce strong triplet S and triplet P series of inner shell excited Ne 1. A total of 60 peaks were found of which 43 were identified. The others are expected to be first members of series formed by two electron excitation of Ne 1 and Ne 2. Dissert. Abstr.

N69-21960 Duke Univ., Durham, N. C.
AN ANGULAR CORRELATION STUDY OF THE LOW LEVELS OF Si-27
Montague B. Lewis (Ph.D. Thesis) 1967 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-11692

The low-lying excited levels of Si^{27} have been studied by the $Si^{26}(He^3,\alpha\gamma)Si^{27}$ reaction. The particle-gamma angular correlation method was used. Most probable spin assignments for the 0.98 MeV, 2.17 Mev, and 2.85 MeV levels were determined as 3/2, 7/2 and 5/2 respectively. Transitions from the 3.84 MeV and 4.13 MeV levels appeared to have isotropic gamma ray angular correlations and decayed primarily through the well established J = 1/2 level at 0.78 MeV. Mixing ratios and branching ratios for many of the gamma ray decays were measured for the first nine levels. Strong and weak coupling model calculations were carried out and the results indicate significant evidence for Si^{28} core excitation configuration in the Si^{27} levels below 3.00 MeV. Many transition properties predicted by the strong coupling model are in conflict with measured values. Dissert. Abstr.

N69-21971 Texas Univ., Austin.
ELECTROPRODUCTION OF PIONS AND THE ELECTROMAGNETIC FORM FACTOR OF PIONS
Konstantinos Filoktiti Lambrakos (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-10855

The possibility of measuring the electromagnetic form factor of the pi-meson by comparing properly the cross section for electroproduction of positive mesons with the cross section for electroproduction of neutral mesons has been investigated. A computer program (ATHENA) was written for the cross section of pion electroproduction and, in addition, a theoretical analysis of the first order Born approximation for the same process was carried out. It becomes apparent from the results of this investigation that an accurate measurement of the pion form factor for momentum transfer higher than $3F^{-2}$ is feasible. Dissert. Abstr.

N69-21988 Texas Univ., Austin.
ELECTRON SCATTERING FROM NITROGEN IONS
Bobby Neal Turman (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-10894

The experimental methods of gas phase electron diffraction were adapted for use in ascertaining the molecular structure of the nitrogen ion N_2^+. An ion deliver system utilizing a duoplasmatron ion source and electrostatic focusing was designed for this experiment. A beam of 45 kilovolt electrons was directed through the ion beam and the electron scattering was recorded photographically. The measured internuclear distance for N_2^+ was compared with the reported value in the literature as an indication of the accuracy of the procedure. Dissert. Abstr.

N69-21990 Miami Univ., Fla.
FIELD ION EMISSION
Nicholas Sama (Ph.D. Thesis) 1968 83 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-11596

The field emission of cesium ions from a positive electrode is formulated for that range of electric field over which an image potential binds the ions to the electrode surface. Recent investigations on the ionization of gas atoms by a metal surface are utilized, in conjunction with steady-state arguments, to yield an expression for the ion supply at the electrode surface. A tunnelling process in the presence of an electric field is then considered, and the ion emission obtained in terms of fundamental constants and pertinent parameters. As part of the overall problem, the effect on the emission current of fractional adsorbed atomic layers on the electrode is examined; not surprisingly, the non-uniform properties of a real electrode lead to the same difficulties in the description of ion emission as are met in the case of electron field emission. Dissert. Abstr.

N69-21991 Texas A&M Univ., College Station.
NUCLEON-NUCLEON SCATTERING THROUGH APPLICATION OF THE PADE APPROXIMATION
William Robert Wortman (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-11484

In an effort to improve upon the predictions of pseudoscalar meson theory, the method of Padé approximants is applied to nucleon-nucleon scattering. All diagrams contributing to the S-matrix through fourth order in the coupling constant are computed by expressing the amplitudes in dispersion relation form by means of Cutkosky's rules. In addition to pion and nucleon intermediate states, other particles occurring in the same representations of

SU(3) as the pion and nucleon respectively are considered subject to both exact SU(3) symmetry and broken mass SU(3) symmetry. The resulting truncated S-matrix is then replaced by a modified S-matrix found by the [1,1] Padé prescription. Phase shifts are computed from the exactly unitary modified S-matrix. Dissert. Abstr.

N69-22007 Texas Univ., Austin.
A STUDY OF NUCLEAR SHELL MODEL CALCULATIONS FOR THE FIRST p SHELL
Lanny Joe Miller (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-10869

A calculation of energy levels and magnetic moments of nuclei with A numbers 6, 7, 8, 12, 13, and 14 is made using a central interaction plus a spin-orbit interaction. A search for equivalent central interactions has also been made. Detailed results are presented for the Rosenfeld interaction and are compared with the results of Barker and Kurath. Dissert. Abstr.

N69-22011 New Mexico Univ., Albuquerque.
A CALCULATION OF PHOTODETACHMENT FROM MOLECULAR OXYGEN
Raymond Pollock, Jr. (Ph.D. Thesis) 1968 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-11682

Using a two-center (spheroidal) coordinate system a one-electron model including direct coulomb, polarization and approximate exchange interactions is developed, and formulas for scattering and photodetachment cross sections are derived. Wave functions representing both bound and free electrons in the field of the neutral molecule are calculated numerically, using adjustable parameters in the exchange and polarization potentials to attain the proper binding energy. The photodetachment cross section is then computed from these wave functions, along with Franck–Condon factors calculated using known vibrational properties of the molecule and the molecular ion. Agreement between calculated and experimental cross sections for oxygen is not satisfactory. Substantial agreement between calculation and experiment can only be achieved by assuming the electron affinity of oxygen to be 0.60 eV instead of the widely accepted value of 0.43 eV. Dissert. Abstr.

N69-22012 Texas Univ., Austin.
A QUANTUM MECHANICAL STUDY OF THE LOWEST $3\Sigma_g$ POSITIVE STATE THE HELIUM MOLECULE
Eddie Michael Greenawalt (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-10837

Variational calculations of the non-relativistic potential energy of the helium molecule were carried out at several internuclear separations. Wave functions of five and fifty valence bond configurations were used. Expansion of the initial five-term wave function led to the formulation of a principle of equal combination of atomic configuration, from which the fifty-term function was derived. Three semi-empirical procedures for adjusting potential curves to their correct limiting values were discussed and applied to the two curves previously obtained. The electronic density distributions of the two wave functions were studied, and a rough correlation between the shape of the density distribution and the shape of the potential energy curve was found. A density difference function was defined and used for analyzing the deficiencies of the fifty-term wave function. Dissert. Abstr.

N69-22014 California Univ., Berkeley.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIOACTIVE TRANSITION-METAL IONS
Warren Clett Easley (Ph.D. Thesis) 1967 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-10311

Electron paramagentic resonance (EPR) was observed in 253d Ag^{110m}, present as Ag^{2+} in the $[(iso\text{-}C_3H_7)_2NCS_2]_2Ag$ complex. Eleven hfs (hyperfine structure) lines were observed, the positions of the other two lines being obscured by other absorptions present in the sample, and the nuclear spin of 6 was confirmed. A hfs constant $a_{110m} = (7.108 \pm 0.02) \times 10^{-3} cm^{-1}$ was determined. A hyperfine anomaly of $\Delta_{107,109} = -0.40\% \pm 0.1\%$ was observed for stable Ag^{2+} in this complex, indicating that the hfs arises from contact interaction. A nuclear moment of $\mu_{110m} = +3.55 \pm 0.04$ nm was derived after a 3.7% hyperfine-anomaly correction. The nuclear moment does not agree with shell-model predictions using empirical g factors, being low by 1 nm. It is suggested that the $(g_{9/2})^7$ proton configuration might be coupled to spin 7/2. This yields a moment of +3.54 nm. Dissert. Abstr.

N69-22019 California Inst. of Tech., Pasadena.
DETERMINATION OF ELECTRONIC ENERGY LEVELS OF MOLECULES BY 90° LOW ENERGY ELECTRON SCATTERING
Pax Samuel Pin Wei (Ph.D. Thesis) 1968 293 p
Avail: Univ. Microfilms: HC $13.30/Microfilm $3.80 Order No. 68-12767

A review of the theory of electron scattering indicates that low incident beam energies and large scattering angles are the favorable conditions for the observation of optically forbidden transitions in atoms and molecules. An apparatus capable of yielding electron impact spectra at 90° with incident electron beam energies between 30 and 50 eV is described. The resolution of the instrument is about 1 eV. Impact spectra of 13 molecules have been obtained. Known forbidden transitions to helium, hydrogen, nitrogen, carbon monoxide, ethylene, and benzene states from ground states have been observed. In addition, singlet–triplet vertical transitions in acetylene, propyne, propadiene, norbornadiene, and quadricyclene, peaking at 5.9, 5.9, 4.5, 3.8, and 4.0 eV (±0.2 eV), respectively, have been observed and assigned for the first time. Dissert. Abstr.

N69-22022 Duke Univ., Durham, N. C.
A STUDY OF Si^{31} WITH Si^{30} (d,p) ANGULAR DISTRIBUTION AND Si^{30}(d,p PHOTON) ANGULAR CORRELATION MEASUREMENTS
Virgil Harris Webb (Ph.D. Thesis) 1968 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-11695

The 0.76, 1.70, 2.32, 2.79, 3.14, and 3.54 MeV levels of Si^{31} have been studied using an angular correlation technique which utilizes a collinear geometry with the observed particles being detected in an annular solid state counter placed at 180° relative to the beam direction. The above levels were populated by the $Si^{30}(d,p)Si^{31}$ reaction with deuteron energies of 3.01 and 3.22 MeV. From the analysis of the experimental correlations, spin determinations of 5/2, 3/2, 7/2, and 3/2 were established for the 1.70, 2.32, 3.14, and 3.54 MeV levels respectively. An isotropic correlation was measured for the level at 760 keV in agreement with the known spin of 1/2 for this level. The analysis for the 2.79 MeV level agrees with the spin values of 3/2 and 5/2 which are allowed by the $l_n = 2$ value from the $Si^{30}(d,p)$ reaction corresponding to population of this level. In addition, information on the gamma-ray multipole mixing ratios and gamma-ray branching ratios for many of the above levels was determined. Dissert. Abstr.

N69-22023 Texas Univ., Austin.
TEMPERATURE DEPENDENCE OF SEVERAL REACTION RATES OF THE HELIUM METASTABLE ATOMS
Claude Randol Jones (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-10850

The temperature dependence of several reactions of both helium metastable atoms was experimentally determined. The reactions were observed in the afterglow of a pulsed helium discharge at several cell temperatures. Time varying optical absorption was used to monitor the exponential decay of the metastable atoms after the discharge pulse. The temperature dependence of the conversion of the metastable atoms to molecular complexes provides an experimental check for recent quantum mechanical calculations. The tertiary conversion of $He(2^3S_1)$ to $He_2(a^3\alpha^+)$ exhibited an activation energy of 0.055 eV. Similarly, the destruction of $He(2^1S_0)$ by collision-induced radiation suggested a potential maximum in the He $(A^1\sum_u^+)$ state of 0.04 eV. Dissert. Abstr.

N69-22026 Fordham Univ., New York.
ATOMIC AND MOLECULAR CALCULATIONS WITH THE PSEUDOPOTENTIAL METHOD
George Albert McGinn (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-11020

The theory of Pseudopotentials is applied to atomic and molecular systems. For the systems to be studied the pseudopotential method replaces by a repulsive potential the orthogonality relationship placed on the valence electrons (in order to satisfy the Pauli exclusion principle) in the normal Hartee–Fock method. This additional repulsive potential is called the pseudopotential. The principal advantage of this method is that the pseudowave function, the eigenfunction connected with the solution of the Schrödinger equation when the pseudopotential is included, contains no orthogonality relationship to the core electrons. The effect of the core electrons is the pseudopotential and not explicitly in valence electron wave function. Thus correlation can be introduced into the pseudo-wave function much more easily than in the corresponding Hartree–Fock type orthogonal valence electron wave function. Dissert. Abstr.

N69-22034 Purdue Univ., Lafayette, Ind.
AN INVESTIGATION OF TWO METHODS FOR INCLUDING INELASTICITY IN THE CALCULATION OF THE p-WAVE PION–PION AMPLITUDE
Barbara Nelson Hale (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12580

Two methods for including the effects of inelasticity on the p-wave pion–pion scattering amplitude are investigated. The first method involves the use of the phase representation in a modified single channel N/D calculation. High energy inelasticity is estimated through the average total phase of the partial wave amplitude for energies, E_γ greater than E_γ. With a Reggeized rho-exchange input force using experimental values for the rho mass and width the results indicate that the assumption of an average total phase of $\pi/2$ for total center of mass energies greater than about 8 M_π does not produce any appreciable reduction in the width of the output p-wave pion–pion resonance. The second method is based on a multichannel, separable potential formalism; the two-channel $(\pi\pi,\kappa\omega)$ problem is considered. A narrow width (150 MEV) for the output resonance at 760 MEV in the $\pi\pi \to \pi\pi$ channel is shown to be possible using a simple Regge-type damping on the rho-exchange potentials. Dissert. Abstr.

N69-22036 Washington State Univ., Pullman.
ALPHA–ALPHA COINCIDENCE STUDY OF THE DECAY OF THE 17.28 MeV LEVEL OF Be^9
Matthew Norton Wise (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-10977

The decay of the 17.28 MeV level of ^9Be was studied through the reaction $^7Li + d \to \alpha + \alpha + n$ at $E_d = 0.8$ MeV. Standard two-parameter techniques, using silicon surface barrier detectors, were employed to detect the two particles in coincidence and display the resulting spectra with 64 × 64 channel resolution. These spectra were projected on one energy axis and weighted by the inverse of the phase space available at each point to facilitate detailed analysis of the decay mechanisms. The data confirms previous results in that it indicates the greatest proportion of the decay proceeds through the ground state of ^5He. However, by subtracting the ground state peaks from the spectra it has been possible to observe the distribution of decay through the broad first excited state of ^5He. The peak in this distribution shifts widely, from 2.5 to 6 MeV excitation, apparently as a result of order-of-emission interference effects. Dissert. Abstr.

N69-22037 Washington Univ., St. Louis, Mo.
PROBLEMS OF THE QUANTUM THEORY OF LIQUID HELIUM
Tollie Bowers Davison (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-10773

An approximate trial function $\bar{\psi}$ representing one-phonon state is tested by evaluating the variance of H, $(H-\bar{H})^2$, the bars denoting expectation values with respect to the assumed trial function. Two procedures for estimating $(H-\bar{H})^2$ are developed and found in one case to depend on the asymptotic behavior of the trial function and in the other to involve the three-particle distribution in a sensitive manner. A second order perturbation calculation is made of the energy of an impurity atom (fermion) in a uniformly extended system of bosons. The results are used to calculate some of the properties of dilute solutions of He^3 in He^4 at low temperatures. An estimate is given of the contribution of the three-phonon vertex to the ground state energy of liquid He^4. Dissert. Abstr.

N69-22038 California Inst. of Tech., Pasadena.
THE EXCHANGE EXCITATION OF HELIUM AND THE HYDROGEN MOLECULE BY LOW ENERGY ELECTRONS
David Chapman Cartwright (Ph.D. Thesis) 1968 312 p
Avail: Univ. Microfilms: HC $14.20/Microfilm $4.00 Order No. 68-12732

The theory of rearrangement collisions involving composite particles is reviewed and the post, prior discrepancy discussed. The recent improvements to the Born–Oppenheimer approximation, the Ochkur (O), and Ochkur–Rudge (OR) approximations are reviewed. These approximations are then used to calculate the total cross section for the electronic excitation, of molecular hydrogen by low energy electrons. Excitations from the ground state to the first and second triplet states are treated. All nuclear motions are taken into account. It is found that the first triplet cross section is sensitive to the choice of the ground state wave function whereas the second is not. The former is also sensitive to the quality of excited state wave function used. The results using the (O) approximation are significantly larger than those of the (OR) approximation, and the maximum cross section occurs at a somewhat lower energy. Dissert. Abstr.

N69-22040 Illinois Univ., Urbana.
PHOTOPRODUCTION OF π^+ MESONS FROM He-3 WITH 340 MeV BREMSSTRAHLUNG

Marvin Blecher (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12083

Cross sections for the coherent photoproduction of π^0 mesons from He^3 were measured for recoil angles of 20°, 30°, 40° and 50° from the direction of the incident photon. A gaseous He^3 target was irradiated by 340 MeV bremsstrahlung. The He^3 gas was maintained at liquid hydrogen temperature and at a pressure of slightly above one atmosphere. The recoil nuclei were observed with silicon semiconductor detectors. At least one gamma ray from the pion decay was detected with a lead glass Cherenkov counter. A coincidence between a semiconductor detector and the Cherenkov counter triggered an oscilloscope on which all pulses were then displayed and photographed. These photographs constitute the experimental data. The experimental results are compared with those predicted by an impulse approximation calculation. Dissert. Abstr.

N69-22041 Yale Univ., New Haven, Conn.
COLLECTIVE NUCLEAR STRUCTURE STUDIES IN THE OSMIUM NUCLEI
Richard Francis Xavier Casten (Ph.D. Thesis) 1968 230 p
Avail: Univ. Microfilms: HC $10.35/Microfiom $3.00 Order No. 68-11166

Collective nuclear structure studies on the four even-even isotopes of osmium were pursued using Coulomb excitation induced by O^{16} ions with incident energies between 42 and 80 MeV obtained from the Yale MP Tandem Van de Graaff accelerator. The deexcitation radiation was observed singly, in coincidence with O^{16} ions backscattered from the target, and in coincidence with other γ-rays. The main emphasis was on the extraction of absolute reduced transition probabilities. These were obtained, for the excitation of all states previously known, by both model-dependent and model-independent analyses. The results were compared with several macroscopic and microscopic nuclear models. Dissert. Abstr.

N69-22044 Texas Univ., Austin.
A STATISTICAL ANALYSIS OF THE P-31(d,α) Si-29 REACTION
George Allen Lock (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-10860

Cross sections for the reaction $^{31}P(d,\alpha)^{29}Si$ have been measured for laboratory deuteron energies from 7.300 to 12.020 MeV. The data have been analyzed in terms of Ericson fluctuation theory from which the coherence width in ^{33}S has been obtained for the whole range of data and for the data divided into halves. The fraction of the reaction proceeding via a direct mechanism has also been determined by Ericson-type analysis. To obtain this fraction, it was necessary to take into account the particle decay of 3.040 channels from the compound nucleus in order to calculate realistically the fluctuation damping coefficient. An effort was made to obtain the spins of the fourth, fifth, and sixth excited states in ^{29}Si by a judicious application of the $2I+1$ rule. Dissert. Abstr.

N69-22050 Stanford Univ., Calif.
WEAK INTERACTIONS IN He3
Earl Andrew Peterson (Ph.D. Thesis) 1968 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-11337

A calculation of ordinary muon capture in He^3 is presented, utilizing information concerning this nucleus to minimize the uncertainties due to the nuclear wave function. An effective Hamiltonian correct through terms of order $(1/\text{nucleon mass})^2$ is employed, and the relativistic terms are treated exactly. The exchange effects are fully discussed, and a phenomenological model is used to calculate their contribution to the capture rate. The elementary particle theory of the weak interactions of the H^3-He^3 system is discussed, in which the nuclear matrix elements are expressed in terms of phenomenological form factors instead of integrals with nuclear wave functions. A sum rule for the axial vector form factor (at zero momentum transfer) is derived and evaluated. Dissert. Abstr.

N69-22052 Washington Univ., Seattle.
THERMAL QUASIPARTICLE RADIATION IN HELIUM 2
Robert William Guernsey, Jr. (Ph.D. Thesis) 1968 219 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-10777

The signals generated by a pulsed, small ($\approx$1 mm square) carbon film heater in a large volume ($\approx$300 cm^3) of helium 2 between 120 and 950 m°K have been studied with particular emphasis at the lower temperatures. The walls of the sample container were sufficiently distant to avoid interference between the early parts of the signal and reflections. The signals from carbon film detectors ($\approx$1 mm square) located at 1, 2, 3 and 4 cm from the source were photographed as the input power flux and sample temperature were varied. These are the first observations of reflection free, thermal quasiparticle radiation in bulk helium 2. Also included in this work is a computation of the quasiparticle radiation expected from a helium 2 black body source such as a heated cavity having a small hole in one side and immersed in the liquid at 0°K. Dissert. Abstr.

N69-22057 Illinois Univ., Urbana.
FAST NEUTRON STREAMING THROUGH CONCRETE DUCTS
Yo Taik Song (Ph.D. Thesis) 1968 351 p
Avail: Univ. Microfilms: HC $16.00/Microfilm $4.50 Order No. 68-12200

The purpose of the work presented is to evaluate the dose variations along the center line in two-legged concrete ducts. The two-legged concrete duct was used as a model for shelter entranceways for the personnel shelters for the initial radiation from nuclear weapons. In the theoretical study, the albedo concept was employed, and numerical values of the neutron dose in ducts of various sizes were calculated by means of an IBM 1620 computer. Three sizes of concrete ducts were used as models: (1) a 3 × 3 foot duct with a first leg length of 15 feet; (2) a 2 × 3 foot duct with a 12 foot first leg; and (3) a 2 × 2 foot duct with 12 foot and 7 foot first legs. In the experiments, counting rates of a spherical dosimeter were measured in both the first and second legs of these ducts for the various neutron sources. Dissert. Abstr.

N69-22060 Duke Univ., Durham, N. C.
PARTIAL WAVE ANALYSIS OF INELASTIC ELECTRON SCATTERING IN NUCLEI CONSIDERING FINITE ENERGY LOSS WITH APPLICATION TO THE GIANT RESONANCES OF MEDIUM AND HEAVY EVEN NUCLEI
Shiang-Tai Tuan (Ph.D. Thesis) 1967 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-11217

Partial wave analysis of inelastic electron scattering from nuclei is treated by the use of Coulomb distorted electron wave functions; the calculation takes into account the nonzero energy loss. The results are compared both to the approximation in which the energy loss is neglected as well as to the Born approximation (in which a plane wave is taken). For the nuclear system the calculations employ a collective model, which treats the coupling of the giant dipole and quadrupole resonances. The transition charge and current (between the ground state and the collective resonance state), which is coupled to the electron motion in the inelastic

electron scattering, are derived and discussed. The partial wave calculation is carried out explicitly to obtain the electron cross sections, which are functions of the scattering angle as well as function of the excitation energy. Dissert. Abstr.

N69-22063 College of William and Mary, Williamsburg, Va.
MEASUREMENTS OF PIONIC AND MUONIC K_α X-RAY ENERGIES IN LOW Z ATOMS
William Beeuwkes Shuler (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-11842

Pionic and muonic K_α X-ray energies have been measured for elements in the range Z = 3 to Z = 6 using high resolution Si(Li) and Ge(Li) γ-ray spectrometers. Level corrections due to vacuum polarization and the finite extent of the nuclear charge distribution have been calculated. The nuclear force shifts due to the strong pion-nucleus interaction have been measured for the 1s levels of pionic atoms and are found to be in fair agreement with the shifts calculated according to the theory of the Ericsons. The X-ray energy and nuclear force shift measurements reported here represent a substantial improvement in precision over previous measurements. Nuclear radii determined from the muonic X-ray data were found to be in agreement with those determined from electron scattering experiments. Dissert. Abstr.

N69-22071 California Inst. of Tech., Pasadena.
THE THEORY OF NEUTRON WAVE PROPAGATION
James Johnson Duderstadt (Ph.D. Thesis) 1968 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-12736

An initial study is made of the eigenvalue spectrum of the velocity-dependent Boltzmann transport operator for plane wave propagation in both noncrystalline and polycrystalline moderators. The point spectrum is discussed in detail, and a theorem concerning the existence of discrete eigenvalues for high frequency, high absorption, and/or small transverse dimensions is demonstrated. The limiting cases of low and high frequency behavior are analyzed. A physical interpretation of the discrete and continuum eigenfunctions (plane wave modes) is given, and the point spectrum existence theorem is explained in the light of such interpretations. Using this spectral representation, a technique for solving full-range boundary value problems for a general noncrystalline scattering kernel is presented. Dissert. Abstr.

N69-22077 Purdue Univ., Lafayette, Ind.
FISSION OF IRIDIUM AT INTERMEDIATE EXCITATION ENERGY
Ronald Lee Brodzinski 1968 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00

The fission resulting from the helium ion bombardment of naturally occurring $_{77}Ir^{191,193}$ was studied radiochemically and by a plastic fission track technique. Thin targets were prepared by vacuum evaporation of iridium metal onto silver and aluminum foils, and absolute cross sections were determined for the production of eleven nuclides from fission induced by 42.2 MeV helium ion bombardment. The excitation function was determined by measuring the total fission cross section at thirteen different energies. Individual fission products were purified, and their activities were measured using low background beta counters. Decay curves and theoretical treatment of the Γ_f/Γ_n data were resolved by computer programmed least squares analyses. The mass distribution was observed to be symmetric with a full width at half maximum of 23 ± 2 mass units. Dissert. Abstr.

N69-22110 Washington State Univ., Pullman.
DESORPTION BY PHOTONS: CARBON MONOXIDE ABSORBED ON NICKEL
John Paul Brainard (Ph.D. Thesis) 1968 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-10947

Desorption of CO on nickel target was induced by radiation with photon energies from 2.1 eV to 4.8 eV. Thermal bulk heating was concluded to be the mechanism by which the photons caused desorption. The same desorption was observed whether the nickel target was heated through an equivalent small change in temperature by ohmic heating or by photon radiation. The wavelength dependence of the photon induced desorption could be ascribed to the wavelength dependence of the thermal absorptivity of nickel. Two weakly bound states were needed to explain this photon induced thermal desorption. It is postulated that CO is adsorbed with a binding energy of 1.06 eV and is desorbed from another state with an activation energy of 0.89 eV. Thermal excitation can explain the transfer of CO from one state to the other. Dissert. Abstr.

N69-22118 Stanford Univ., Calif.
THE RADIATIVE CAPTURE OF HEAVY IONS
William Charles Feldman (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-11292

The process of radiative capture of heavy ions was successfully observed by means of the high energy gamma radiation produced in the reactions $^{7}Li(^{16}O,\gamma)^{23}Na$, $^{11}B(^{12}C,\gamma)^{23}Na$, $^{9}Li(^{16}O,\gamma)^{25}Na$, $^{12}C(^{12}C,\gamma)^{24}Mg$ and $^{12}C(^{16}O,\gamma)^{28}Si$. Particle beams were produced by means of the Stanford Tandem Van de Graaff accelerator. Gamma rays were detected by means of a specially designed 24 cm diameter × 24 cm long NaI(Tl) crystal encased in an NE 102 plastic anticoincidence shield. Dissert. Abstr.

N69-22119 Texas A and M Univ., College Station.
TOTAL REACTION CROSS SECTIONS FOR PROTONS BETWEEN 10 MeV AND 22 MeV ON C-12 AND Ca-40
John Francis Dicello, Jr. (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-11452

Total reaction cross sections for protons on ^{40}Ca have been measured at fifteen energies between 10.3 MeV and 21.8 MeV by the beam attenuation method. The differential elastic cross sections for protons on ^{40}Ca have been obtained at fifteen energies between 9.8 MeV and 21.7 MeV. Total reaction cross sections for protons on carbon have been measured at ten energies between 9.8 MeV and 19.5 MeV. The total reaction cross section for ^{40}Ca rises sharply at low energies, reaches a maximum value around 13 MeV, and reaches a minimum around 16 MeV. The present differential elastic cross sections and total reaction cross sections for ^{40}Ca are compared with predictions of the optical model. The total reaction cross sections for carbon show resonant-like structures in the neighborhood of 10.4 MeV and 13.8 MeV. Dissert. Abstr.

N69-22121 Colorado Univ., Boulder.
PRESSURE BROADENING OF THE 60-GHz MICROWAVE LINES OF OXYGEN
Richard Lawerance Abbott (Ph.D. Thesis) 1967 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-10699

The widths of several microwave lines of molecular oxygen were calculated using Anderson's theory. Calculations for low pressures indicated the line widths parameters were almost independent of the angular momentum for the lines near 60 GHz. Experimental results indicated the calculations were probably correct. The calculations also indicated that moderate overlap of

adjacent lines probably does not change the line widths substantially. The intermolecular potentials were fixed by fitting the equation parameters to the data. Dissert. Abstr.

N69-22127 Stanford Univ., Calif.
PROPERTIES OF LEVELS OF Fe 57 FROM COULOMB EXCITATION RECOIL IMPLANTATION EXPERIMENTS
Gene Denson Sprouse (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-11352

Electromagnetic properties of the low lying levels of the nucleus Fe were studied by Coulomb excitation with alpha particles of energy 3 MeV and oxygen ions of energy 12–36 MeV. Angular distribution measurements were used to determine E2/M1 mixing ratios for the deexcitation gamma rays. The reduced transition probabilities obtained from the measured lifetimes are in agreement with those obtained from Coulomb excitation. The magnetic moment of the 136 keV 12.6 nanosecond level of Fe was measured in an external field of 11 kiloGauss with an integral precession method. Precession measurements on the 367 keV level of Fe in a magnetized iron foil gave a null result, indication that either /g(367)/ is equal to or greater than 0.4, or that the average field acting on the iron recoil during its lifetime of 10 picoseconds is smaller than the internal field of 333 kiloGauss determined from the Mossbauer effect. Dissert. Abstr.

N69-22130 Kansas State Univ., Manhattan.
COLLISION BROADENING OF LINES IN INFRARED ROTATION-VIBRATION BANDS
An-Ti Chai (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-9903

The self-broadening effects of carbon monoxide molecules for individual lines in the CO fundamental rotation-vibration band were compared with the broadening effects of foreign gases H_2, D_2, N_2, He, Ne, Ar, Kr, and Xe. For each pair of gases studied, the observed values of the self-broadening coefficient in the CO fundamental were satisfactorily expressed in terms of the proposed scheme, which involved only three parameters. Predictions based on this proposed interpretation were tested by experimental studies of CO_2 and N_2O and found to be qualitatively correct. The collision cross sections obtained in the present study were in fair agreement with direct measurements made by earlier investigators and differences were noted and discussed. Dissert. Abstr.

N69-22135# Indiana Univ., Bloomington.
PROTON POLARIZATION IN THE Ca-40(dp) Ca-41 REACTION
Charles Thomas Kelley, Jr. (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-11392

The present experiment was proposed to measure the proton polarizations corresponding to several final states in a stripping reaction that has been studied by the above theories, in order to compare the proton polarization predictions and to provide new data for additional future theoretical analysis. The polarization of protons corresponding to the ^{40}Ca (d,p) ^{41}Ca ground state, 1.95-, and 2.47-MeV reactions have been measured at 13 angles between 30° and 148° (lab.) at a deuteron bombarding energy of 10.8 MeV. The polarization results for the ground-state reaction are in good agreement with previous results at a similar deuteron bombarding energy, although the present work extended over a wider angular range. A comparison between the ground-state proton polarization and the three theories mentioned above was made, although the theoretical predictions are only considered to be preliminary. Reasonable agreement was found with the Sudden Approximation. Dissert. Abstr.

N69-22140 California Univ., Berkeley.
MOLECULAR BEAM ELECTRIC RESONANCE SPECTROSCOPY OF LITHIUM HYDRIDES
Elaine Rothstein (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-13951

Radio frequency spectra were observed in the first rotational state of Li^7H, Li^7D, Li^6H, and Li^6D. Analysis of the spectra enabled the determination of accurate dipole moments and nuclear hyperfone interaction constants. The experimental values were compared to the available quantum mechanical calculations. The polarizable ion model was also compared to the experiment. Dissert. Abstr.

N69-22144 Yale Univ., New Haven, Conn.
METASTABLE HYDROGEN ATOM PRODUCTION BY ELECTRON CAPTURE
James Edward Bayfield (Ph.D. Thesis) 1968 208 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-11157

Cross section measurements were made for proton collisions incident on atomic hydrogen, helium, argon, and molecular hydrogen gases. The proton energy range was 3 to 23 keV. Proton collisions with argon and helium were in good agreement with previous investigations, and the results were used to calibrate the equipment. A comparison of the present data with theoretical results for the process $H+ + H(1s) \rightarrow H+$, for which several different cross section calculations have been derived previously, is also made. The importance of excited state production is included in a discussion of fast proton collisions with hydrogen atoms. The total electron capture process $H^+ + H(1s) \rightarrow H + H^+$ was reinvestigated. Some information related to the angular distribution of fast H(2s) produced in $H^+ - H(1s)$ collisions was also obtained. Dissert. Abstr.

N69-22147# Union Carbide Corp., Oak Ridge, Tenn. Gaseous Diffusion Plant.
MEASURING FISSION PRODUCT ACTIVITY IN URANIUM CONTAINING U-232 DAUGHTERS
A. R. Flynn 12 Dec. 1968 9 p refs
(Contract W-7405-eng-26)
(K-1757) Avail: CFSTI

The method for measuring fission product activity in uranium hexafluoride was adapted to material produced from spent nuclear fuel containing ^{232}U and its daughters; a convenient gamma spectrometer correction for the daughters; a convenient gamma spectrometer correction for the daugher activity is used. The uranium and thorium are extracted into tributyl phosphate, leaving the fission products and the ^{232}U daughters (excapt ^{228}Th) in the aqueous phase. The total gamma activity of the aqueous phase is measured in a high-pressure ionization chamber as specified and corrected for the ^{232}U daughter activity, using a correlation between the gamma activity of ^{208}Tl (a ^{232}U daughter) and the total gamma activity of the ^{232}U daughters. To establish this correlation, the uranium is extracted from ^{232}U standards; the remaining ^{208}Tl is measured by gamma spectrometry, and the total gamma activity is measured with the high-pressure ionization chamber. A similar correction is made for the beta activity of the ^{232}U daughters, using a correlation established between the ^{208}Tl gamma activity and the total beta activity of the ^{232}U daughters. Author (NSA)

N69-22160 Yale Univ., New Haven, Conn.
COLLISION DOMINATED POSITIVE COLUMN OF A WEAKLY IONIZED GAS
Joel Lawrence Blank (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-11159

The well-posed boundary value problem of the positive column is treated using the Boltzmann equation to govern the behavior of the electrons. The problem is solved completely for the case of a constant electron-neutral recoil collision time for momentum transfer in the limit where inelastic collisions play a weak role in determining the shape of the body of the electron distribution function. The electron boundary layer is treated systematically in accordance with the method of matched asymptotic expansions. A detailed analysis for the case of a quasi-neutral positive column is presented and the proper form of the ambipolar diffusion coefficient is determined. An inner–outer expansion technique is employed to obtain a self-consistent solution. Dissert. Abstr.

N69-22168*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NUMERICAL CALCULATION OF ELECTRON-ATOM EXCITATION AND IONIZATION RATES USING GRYZINSKI CROSS SECTIONS
R. Goldstein 1 Mar. 1969 10 p refs
(Contract NAS7-100)
(NASA-CR-100546; JPL-TR-32-1372) Avail: CFSTI CSCL 20H

Gryzinski classical cross sections and Maxwellian electron distributions were used to obtain a simple analytical expression which represents the calculations within ±5% over the range of electron temperatures and atomic parameters considered to be physically most important. Transition rates calculated from a linear approximation to the cross sections showed less agreement with the exact values than this analytical expression. Author

N69-22189# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
RADIOGRAPHIC EXPOSURE CHARTS FOR RADIOISOTOPE SOURCES
P. A. Gillespie Jun. 1968 18 p refs
(AAEC/TM-460) Avail: CFSTI

Radiographic exposure charts prepared for cobalt-60, cesium-137, cesium-134 and iridium-192 with steel, and for thulium-170 with aluminum, are presented as a practical guide for the radiographer. Experimental procedures used in compiling the charts are described and a summary is given of the factors influencing exposure time. Author (NSA)

N69-22201 Illinois Univ., Urbana.
SOME RESULTS OF THE ALGEBRA OF CURRENTS IN WEAK INTERACTIONS. PART 1: THE DECAYS KAON YIELDS 2 PI AND KAON YIELDS 2 PI GAMMA. PART 2: RELATION BETWEEN VECTOR AND AXIAL-VECTOR CABIBBO ANGLES IN BROKEN SU(3) SYMMETRY
Nasrallah Fares Nasrallah (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12172

A study of the decays $K^+ \rightarrow \pi^+\pi^0$ and $K^0 \rightarrow 2\pi$ using the algebra of currents is presented. The decay $K^+ \rightarrow \pi^+\pi^0$ is not due to the violation of the selection rule $\Delta I = 1/2$ caused by the electromagnetic mass difference is shown, counted for by the $I = 3/2$ part of the weak Hamiltonian. The renormalization is calculated of the weak axial-vector coupling constant in the decay $\Sigma^- \rightarrow \Sigma^+ e^- \nu$ on the basis of the assumption that the symmetry breaking is unimportant at high energies. The result is used to show that the equality between vector and axial-vector Cabibbo angles, which is expected to hold in the limit of exact SU(3) symmetry, is preserved by the symmetry breaking. Dissert. Abstr.

N69-22202 Illinois Univ., Urbana.
MEASUREMENT OF THE STRONG INTERACTION FORM FACTOR AND THE CHARGE ASYMMETRY IN THE DECAY K SUB L YIELDS NEGATIVE/POSITIVE PIONS PLUS POSITIVE/NEGATIVE ELECTRONS PLUS NEUTRINO/ANTI NEUTRINO
Lynn James Verhey (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12215

An experiment has been performed which measures the energy dependence of the strong interaction form factor and the charge asymmetry. The events were identified by the observation of an electron shower in a set of shower spark chambers, reconstructed by the measurement of the charged particle moments from the observed trajectories in a spark chamber which was inside a magnetic field, and analyzed under the assumption of $K_L^0 \rightarrow$ xeν. The Dalitz plot distributions were obtained for all those events with electron energies greater than 350 MeV which were found to have properly traversed the apparatus without scattering in the magnet. A Monte Carlo calculation was made of the expected Dalitz plot distributions for each of several assumptions about the strong interaction form factor. Dissert. Abstr.

N69-22203 Case Western Reserve Univ., Cleveland, Ohio.
MEASUREMENT OF THE STATIC ELECTRIC QUADRUPOLE MOMENT OF THE 0.558 MeV 2 PLUS STATE IN Cd 114 BY MEANS OF THE REORIENTATION EFFECT IN COULOMB EXCITATION
Gerd Schilling (Ph.D. Thesis) 1967 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-10180

The static electric quadrupole moment of the 0.558 MeV 2+ state in the $^{114}_{48}Cd$ nucleus has been measured by observing the differential excitation probability of 25 MeV incident ^{16}O ions. Deviations of the excitation probability from first-order Coulomb excitation theory are interpreted in terms of the reorientation effect of Breit to yield $Q(2+) = -0.64 \pm 0.19 \times 10^{-24}$ cm^2, which is in strong disagreement with the vanishingly small prediction of the pure vibrational model. The experimental technique of using a large scintillator close to the target to gate several ion detectors in order to separate inelastic ions allows the measurement to be performed at low incident beam energy, where higher-order corrections involving virtual transitions to higher excited states contribute a small uncertainty to the reorientation effect. Dissert. Abstr.

N69-22210 Colorado Univ., Boulder.
STRUCTURE OF Ni-60, Ti-48, AND Si-28 AS INVESTIGATED BY 37.7 MeV (He–3,d) AND 21.2 MeV (p,p') SCATTERING STUDIES
Ralston White Barnard (Ph.D. Thesis) 1968 218 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-12390

The structure of ^{60}Ni, ^{48}Ti, and ^{28}Si is studied by means of the (^{3}He,d) proton transfer reaction on ^{59}Co, ^{47}Sc, and ^{27}Al targets, and by means of (p,p') inelastic scattering on ^{60}Ni, ^{48}Ti, and ^{28}Si. Angular distributions for elastically scattered ^{3}He are obtained in the angular range 5°–90° for all nuclei and to 150° for ^{59}Co. Reaction angular distributions are obtained from 10° to about 70° for all nuclei. The proton elastic and some strongly excited inelastic scattering angular distributions are obtained from 10° to 180° for all target nuclei, while those of the weaker states are observed to 130°. Energy resolution is of the order of 80 keV and 50 keV for the ^{3}He and proton scattering, respectively. Analysis of the (^{3}He,d) and (p,p') data employs the distorted wave Born approximation. The (p,p') analysis involves both the collective and shell models. Dissert. Abstr.

N69-22216 Iowa Univ., Iowa City.
POSITRON ANNIHILATION IN SMALL ATOMS
Charles Frank Lebeda (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-10670

A number of calculational techniques are considered for use on the simple systems positronium hydride and the complex of a positron and a helium atom. A variation–perturbation calculation using a cusp-satisfying zero order wave function is tested and found to yield a too-slowly convergent power series. A variation–perturbation technique which uses accurate variational wave functions as the zero order wave function, is tested and found not to converge rapidly enough. An iterative calculation is also tested and found not to converge rapidly enough, either. A Rayleigh–Ritz variational calculation is then carried out. A twelve term expansion, used with the open shell exponential function, yields a ground state energy of −0.7742 au, or a binding energy of 0.657 eV for Ps to H. The mean life-time for the positron is 2.66 × 10-10 sec. A seventeen term expansion, with the closed shell exponential function, yields an energy of −0.7724 au. The system of a helium atom and a positron is found not to be bound. Dissert. Abstr.

N69-22249# Pennsylvania Univ., Philadelphia. Dept. of Physics.
THEORETICAL AND EXPERIMENTAL RESEARCH ACTIVITIES IN HIGH-ENERGY PHYSICS Progress Report, Sep. 1967–Sep. 1968
20 Dec. 1968 63 p refs
(Contract AT(30-1)-2171)
(NYO-2171-259) Avail: CFSTI

Theoretical research, including elementary particle physics and nuclear structure, and experimental research, including weak and strong interactions, are discussed. Technical developments and experimental support activities are described. Current publications are also presented. NSA

N69-22275# Brookhaven National Lab., Upton, N. Y.
THE ELECTRIC DIPOLE MOMENT OF THE NEUTRON
Victor W. Cohen 30 Aug. 1968 24 p refs Presented at Conf. on Phys. of the 1 and 2 Electron Atoms, Munich Sponsored by AEC
(BNL-12816; Conf-680934-1) Avail: CFSTI

Various attempts to measure the electric dipole moment of the neutron are reviewed. The principles of the various experiments, their limitations, and a summary of the results are discussed. NSA

N69-22284# California Univ., Livermore. Lawrence Radiation Lab.
THE EFFECTS OF HEAT TREATMENTS OF GERMANIUM ON RESISTIVITY, PHOTOCONDUCTIVE DECAY AND ON LITHIUM DRIFT PROPERTIES
Erwin Fischer-Colbrie, T. G. Brown, and A. V. Friansehner Oct. 1968 13 p refs Presented at 15th Nucl. Sci. Symp., Montreal, 23 Oct. 1968 Revised
(Contract W-7405-eng-48)
(UCRL-71082-Rev-1; Conf-681017-10) Avail: CFSTI

It was found that, in contrast to literature, thermally produced acceptors cannot be reconverted if vacuum is used instead of a gas during anneal treatments. Vacuum heat treatments also lead to a stronger decrease of the photoconductive decay time than a gas atmosphere does. Close to theoretical lithium drift rates considerably decrease in heat treatments, poor drift rates can be improved. The effects of quenching differ distinctly from those of slow cooling. The surface exposed to vacuum can be assumed to be a more abundant source of single vacancies due to a lower density of sorption engagements. Single vacancies diffuse then rapidly into the bulk and become less mobile in interactions, possibly with (interstitial) copper, thus providing stable p-sites. Author (NSA)

N69-22295 Texas Univ., Austin.
QUANTUM MECHANICAL STUDY OF THE $F^1\pi_g$ AND $f^3\pi_g$ STATES OF He_2
Balkrishna Gupta (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-10838

A quantum mechanical study of two states of the helium molecule is made using the valence bond method with configuration interaction. The variation principle is employed to insure that the energy calculated is a rigorous upper bound to the true energy. The existence of maxima in the potential energy curves of the states under study is discussed in terms of the noncrossing rule and the molecular state correlation diagrams. A semi-empirical pseudo-kinetic energy correction is applied to the potential energy curves. Dissert. Abstr.

N69-22296# California Univ., Berkeley. Lawrence Radiation Lab.
A COMPUTER-BASED SYSTEM FOR THE NUCLEAR DATA COMPILATION "TABLE OF ISOTOPES"
C. M. Lederer, J. M. Hollander, and I. P. Meissner Oct. 1968 38 p
(Contract W-7405-eng-48)
(UCRL-18530) Avail: CFSTI

A fully computer-based system for producing future editions of the table of isotopes is described. Author (NSA)

N69-22298 Case Western Reserve Univ., Cleveland, Ohio.
ELASTIC AND INELASTIC SCATTERING OF POLARIZED 2.33 MeV NEUTRONS FROM C 12, Fe 54, Fe 56, Ni 58, Ni 60 AND Cu 65
William Leslie Rogers (Ph.D. Thesis) 1967 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-10178

Time-of-flight techniques were used to observe the scattering of polarized 2.33 MeV neutrons from cylindrical samples of C^{12}, $Fe^{54,56}$, $Ni^{58,60}$ and Cu^{65}. The neutrons were produced by the C^{12} (d,n) reaction at 30°. Left and right counting rates were simultaneously measured for 5 scattering angles between 30° and 120°. Polarizations and cross sections normalized to the C^{12} cross section are given for elastic scattering and inelastic scattering. The polarization observed for C^{12} is in agreement with that calculated from the phase shifts of Wills. The polarization observed for elastic scattering from the other elements was less than 0.2 at all angles. The inelastic angular distributions were predominantly isotropic and the measured inelastic asymmetries were consistent with zero. Dissert. Abstr.

N69-22308# California Univ., Berkeley. Lawrence Radiation Lab.
TRANSVERSE SPACE-CHARGE EFFECTS IN CIRCULAR ACCELERATORS
Frank James Sacherer (Ph.D. Thesis) 30 Oct. 1968 123 p refs
(Contract W-7405-eng-48)
(UCRL-18454) Avail: CFSTI

The quadrupole mode of oscillation that is excited in uniformly charged beams by gradient errors is examined. Self-consistent equations of motion are derived for the beam envelope and these equations are solved for the case in which the space-charge force is much less than the external focusing force for strong-focusing synchrotrons. It is shown that the resonance intensity is shifted

from the value predicted by the usual transverse incoherent space-charge limit; moreover, because the space-charge force depends on the shape and size of the beam, the beam growth is always limited. Other modes of collective oscillation that are excited by machine imperfections are examined. Only one-dimensional beams that are confined by harmonic potentials and only small-amplitude oscillations are considered. The linearized Vlasov and Poisson equations are used to find the twofold infinity of normal modes and eigenfrequencies for the stationary distribution that has uniform charge density in real space. Author (NSA)

N69-22336# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.

SEARCH FOR A BARYON NUCLEON KAON PION RESONANCE WITH STRANGENESS S EQUALS PLUS 1 IN THE REACTION NEGATIVE PION PROTON YIELDS NUCLEON KAON ANTIKAON PION AT INCIDENT NEGATIVE PION MOMENTUM OF 3.25 GeV/c

V. V. Vladimirskii et al Apr. 1968 15 p refs Transl. into ENGLISH of Russian rept. ITEF-584
(NP-tr-1721) Avail: CFSTI

The investigation of the final state $NK\overline{K}\pi$ shows a considerable generation of $Y^*_0(1520)$, $Y^*_0(1815)$ and $K^*(892)$ resonances at the incident pion momentum 3.25 BeV/c. Evidence is obtained for the possible existence of the $NK\pi$-resonances with the positive strangeness about 1.8 BeV. Author (NSA)

N69-22341# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

NUMERICAL ANALYSIS OF RESONANCE INDUCED BY s WAVE NEUTRONS IN TRANSMISSION TIME-OF-FLIGHT EXPERIMENTS WITH A COMPUTER IBM 7094/II [METHODE D'ANALYSE DES RESONANCES INDUITES PAR LES NEUTRONS s DANS LES EXPERIENCES DE TRANSMISSION PAR TEMPS DE VOL ET AUTOMATISATION DE CES METHODES SUR ORDINATEUR IBM 7094/II]

Charles R. Gorge (Ph.D. Thesis) Jan. 1969 318 p refs In FRENCH; ENGLISH summary
(CEA-R-3236) Avail: CFSTI

The numerical analysis of transmission resonances induced by s wave neutrons in time-of-flight experiments can be achieved in a fairly automatic way on an IBM 7094/II computer. The computations involved are carried out with the following four step scheme: 1) the experimental raw data are processed to obtain the resonant transmissions, 2) the values of the experimental quantities for each resonance are derived from the above transmissions, 3) the resonance parameters are determined using a least squares method to solve the over determined system obtained by equalling theoretical functions to the corresponding experimental values, 4) a graphical control of the results is carried out. Author (ESRO)

N69-22342*# Lockheed Electronics Co., Houston, Tex.

SPIN-OTHER-ORBIT MATRIX ELEMENTS FOR f^4 CONFIGURATIONS

J. A. Barnes, B. L. Carroll, and L. M. Flores Feb 1969 14 p refs
(Contract NAS9-5384)
(NASA-CR-99610) Avail: CFSTI CSCL 20H

The Spin-Other-Orbit matrix elements for f^4 electron configurations are computed and tabulated for general use. Author

N69-22345# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.

STUDY OF NIOBIUM ISOTOPES HAVING EXCESS NEUTRONS AND A SHORT HALF-LIFE [ETUDE DES ISOTOPES DU NIOBIUM EXCEDENTAIRES EN NEUTRONS ET DE COURTE PERIODE]

Karlheinz Hubenthal (Ph.D. Thesis--Grenoble Univ., 21 Feb. 1968) Nov. 1968 56 p refs In FRENCH; ENGLISH summary
(CEA-R-3513) Avail: CFSTI

By irradiating Mo with 14 MeV neutrons isomers have been found for ^{99}Nb (2.8 s half-life) ^{99}Nb(9 s) and ^{100}Nb (2.4 s). No isomer of this type seems to exist for ^{98}Nb. Rapid separation methods are developed for isolating ^{99}Zr from fission products, and for separating Zr and Nb. The half-life of ^{99}Zr is measured (31 s) and the formation of ^{99}Nb (2.8 s) from ^{99}Zr (31 s) is demonstrated. Rough β and γ measurements of these nuclei are described. The γ spectrum of ^{99}Nb (61 min) is studied with a high-resolution Ge/Li-detector. Author (ESRO)

N69-22407# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.

EFFECTS OF TEMPERATURE ON ORGANIC PLASTIC SCINTILLATORS

R. J. Salem 19 Sep. 1968 15 p
(Contract AT(29-2)-656)
(GEPP-44) Avail: CFSTI

The effects of temperature on two similar plastic scintillators, Pilot B and Pilot M, are given. The neutron detection efficiency of scintillators is reduced when exposed to excessive temperature (>135°F) for prolonged periods of time. Temperature sensitivity tests show that a permanent shift in the level of $\overline{Q}$ occurs between 127°–137°F for the Pilot B scintillator and between 169°–179°F for the Pilot M scintillator. $\overline{Q}$ is a ratio of the integrated fluor output pulse for a test detector to the integrated fluor output pulse for a standard detector. Differential thermal analyses show that the molecular structure of the fluor is changed drastically between 122°–144°F for the Pilot B scintillator and between 184°–193°F for the Pilot M scintillator. Author (NSA)

N69-22420# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

STUDY OF THE NEUTRON STRENGTH FUNCTION AND OF THE DIFFUSION RADIUS AS A FUNCTION OF MASS NUMBER [ETUDE DE LA FONCTION DENSITE DE NEUTRON ET DU RAYON DE DIFFUSION EN FONCTION DU NOMBRE DE MASSE]

Joseph Morgenstern (Ph.D. Thesis) Sep. 1968 203 p refs In FRENCH; ENGLISH summary
(CEA-R-3609) Avail: CFSTI

The strength functions S_0 and S_1, and the scattering length R' are studied. The values of S_0, S_1 and R' are obtained by shape analysis of the individual resonances observed in total neutron cross-section measurements. These measurements were performed with the Saclay 45 MeV linac by the time of flight method. The best resolution achieved was equal to 0.19 ns/m. Particular attention was paid to the nuclei around mass numbers A = 50, 90, 140 and 200. The experimental values of S_0, S_1 and R' are compared with optical model calculations and a fairly good agreement is obtained using an optical potential with surface absorption. Author (ESRO)

N69-22423# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

ELECTRON EMISSION OF ALKALINE AND ALKALINE-EARTH VAPORS ABSORBED ON REFRACTORY METALS [EMISSION ELECTRONIQUE DES METAUX ALCALINS ET ALCALINO-TERREUX ADSORBES SUR LES METAUX REFRACTAIRES]

Thierry Alleau and Jean-Louis Desplat Jan. 1969 76 p refs In FRENCH; ENGLISH summary
(CEA-R-3723) Avail: CFSTI

This work has been carried out as an aid to research on thermionic converter electrodes. The improvement of the converter efficiency makes it necessary to explain physically the adsorption process, and to determine theoretically its laws. The Gyftopoulos, Levine, Steiner's recent theory has been used to plot, by means of a computer, the 'S' shaped curves which bind the electron emission of adsorbed alkaline and alkaline-earth metals to their temperature and to the substrate temperature. Twenty-one examples are presented, some of them being studied with crystallographic orientation. Author (ESRO)

N69-22427# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
3.55 GeV/C Kp ELASTIC SCATTERING NEAR 180° [DIFFUSION ELASTIQUE DES K de 3.55 GeV/C PAR LES PROTONS, AU VOISINAGE DE 180°]
Jean Duflo (Ph.D. Thesis—Paris Univ., 6 Mar. 1968) Jan. 1969 105 p refs In FRENCH; ENGLISH summary
(CEA-R-3685) Avail: CFSTI

Backward elastic K^+p and K^-p scattering has been measured in the angular interval 168° to 177°. The experimental apparatus included optical spark chambers to measure the three prongs of the event scattering, a set of scintillation counters and Cerenkov counters to select events and trigger chambers, and a magnet to determine the moment of the recoil proton. 106 000 photographs were taken. Of these, 22 satisfied all requirements as elastic K^+p scattering events. No event was found to satisfy the kinematical criteria for K^-p elastic scattering. The corresponding values of the differential cross sections are: $(d\sigma/d\Omega)K^+p \rightarrow pK^+ = 17 \pm 4$ μb/sr and inelastic scattering were estimated. Elastic scattering K^+p exhibits a backward peak. A reasonably satisfactory interpretation of the results is obtained by exchange models. There are, in fact, no definitely established particles which could take part in the $Kp^- \rightarrow pK^-$ exchange process. This is in good agreement with the small value of the K^-p backward elastic scattering cross section. The results lend support to the conclusions of the interference model developed by Barger and Cline for the πp backward scattering, and to the qualitative predictions of the Quark models. Author (ESRO)

N69-22453# Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION, CHRESTOMATHY, 1968
Dec. 1968 64 p
(Contract W-7405-ENG-26)
(ORNL-TM-2337) Avail: CFSTI

The relativistic motion of a charged particle in the field of a plane circularly polarized electromagnetic wave propagating along a constant magnetic field B_0 is considered. The longitudinal portion of the Lorentz force leads to a Doppler frequency shift of the field acting on the particle. If the phase velocity v_{ph} of the wave equals c, this shift is compensated by a decrease in the ion gyromagnetic frequency, which makes possible continuous resonance acceleration of the particle. If $v_{ph} \neq c$, such compensation is impossible. The equation of motion is solved exactly, and a number of particular cases are considered. For $v_{ph} \neq c$, the amplitude of oscillations of the ion energy and the average energy both decrease with an increase of the initial perpendicular velocity or of the relative frequency difference. The results are used to calculate the current produced by the plane wave in a uniform infinite collisionless plasma. The particle energies increase as a result of the cyclotron heating. The asymptotic form of the energy distribution function for $t \rightarrow \infty$ is found. NSA

N69-22503*# Techtran Corp., Glen Burnie, Md.
THE STATISTICAL THEORY OF MANY PARTICLES [K STATISTICHESKOY TEORII MNOGIKH CHASTITS]
D. A. Kirzhnits Washington NASA Apr. 1969 69 p refs Transl. into ENGLISH from Nekot. Vopr. Teor. Fiz. (Moscow), v. 16, 1961 p 3–49
(Contract NASW-1695)
(NASA-TT-F-12157) Avail: CFSTI CSCL 20H

The statistical method of the theory of many particles (known under the name Thomas–Fermi Method) is broadly used in the most varied areas of physics and related sciences. Without entering into details the authors list the problems, in the solutions of which this method has an important role to play. These include problems of the structure of atoms and molecules; the theory of the metallic and in general the crystalline state of material; problems related to the equations of state of matter; the problem of the interaction of high speed particles with matter, the structure of the atomic nucleus, etc. Dirac gave the method a quantum mechanics interpretation. This approach allows the statement and solution of the essential problem concerning the limits of applicability of the Thomas–Fermi method and its corresponding correction in those cases when the conditions of its applicability are disrupted. Author

N69-22547# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
TABLES OF EVALUATED NEUTRON CROSS SECTIONS FOR FAST REACTOR MATERIALS
I. Langner, J. J. Schmidt, and D. Woll Jan. 1968 663 p Work performed under US-Euratom Fast Reactor Exchange Program
(KFK-750; EUR-3715; EANDC(E)-88-U; EURFNR-537) Avail: CFSTI

Tables of evaluated data, as functions of incident neutron energy, are presented for the neutron cross sections and resonance parameters of materials that are of particular interest in the design of fast and intermediate reactors. The materials covered include C, Cr, He, H, Fe, Mo, Ni, O, ^{239}Pu, Na, ^{235}U, and ^{238}U. NSA

N69-22556# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
RETARDATION IN THE ELASTIC SCATTERING OF PHOTONS BY ATOMIC HYDROGEN
M. Gavrila and A. Costescu 1968 26 p refs
(IFA-FT-70) Avail: CFSTI

The matrix element for the elastic scattering of photons by atomic hydrogen is evaluated analytically in closed form in the nonrelativistic case including retardation. The method of integration is similar to the one used previously by one of the authors for the dipole approximation. It is based on the possibility of expressing the matrix element in terms of the Green's function for the Coulomb field in momentum space, for which an integral representation derived by Schwinger and others is then used. Some integrations yield the matrix element in terms of essentially two hypergeometric functions of Appell's type F_1, with variables and parameters depending on the photon energy. A preliminary discussion of the result is given. Author (NSA)

N69-22559# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
ON A COUPLING BETWEEN QUADRUPOLE AND OCTUPOLE PHONON STATES
A. A. Raduta et al 1968 26 p
(IFA-FT-68) Avail: CFSTI

The 1^-, 1^-, 3^-, 4^-, 5^- quintet arising from coupling of quadrupole and octupole vibrations was previously studied taking into account all the independent terms of third and fourth

degree in momentum that were invariant under inversions and rotations. A reformulation is presented in which the cubic term in momentum in the Hamiltonian is excluded. The quintet shift and the electromagnetic transition rates to the first 2^+, 3^- excited states are evaluated by linearizing the motion equations containing only the anharmonic terms arising from quadrupole interaction. NSA

N69-22563# Institut Fiziki Vysokikh Energii, Serpukhov (USSR).
FROM WHAT EXPERIMENTAL DATA IS IT POSSIBLE TO DETERMINE THE DEGREE OF VIOLATION OF THE RULE DELTA T EQUALS ONE-HALF IN DECAY KAON YIELDS 3 PION?
U. V. Anisovich, L. G. Dakhno, and A. K. Likhoded 1969 14 p refs In RUSSIAN
(IFVE-STP-68-2-K) Avail: CFSTI

The question is being studied how much the fi- and K-mass differences affect the $\Delta T = 1/2$ violation. It is shown that the division of the total decay rates into their phase space, as is usually the case, does not exclude entirely the effect of mass differences on the total decay rates. Owing to the fi- and K-mass differences in various decays the physical region is shifted as well as the middle point of the Dalitz plot. Since the matrix elements of the $K \rightarrow 3fi$ decay depend essentially on the pion energy, the appreciable corrections appear in the total decay rates (of the order 10%). As a result of claiming a 40% precision, the only relation exists in the case when the $T = 1/2$ rule is fulfilled. If the π-fi- interaction at low energy is small. These relations are violated only by the transitions with $\Delta T = 5/2$ and $\Delta T = 7/2$. In conclusion other possibilities for determining the corrections to the $\Delta T = 1/2$ rule in $K \rightarrow 3h$ decays are discussed. Author (NSA)

N69-22566# California Univ., Berkeley. Lawrence Radiation Lab.
TABLES OF STRUCTURE AMPLITUDES FOR (p,t) REACTIONS
Norman K. Glendenning Jun. 1968 43 p refs
(Contract W-7405-eng-48)
(UCRL-18268) Avail: CFSTI

Tables of structure amplitudes for (p,t) reactions on A = 4 through 224 nuclei are presented. NSA

N69-22646# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL STUDIES ON THE METASTABLE LIFETIMES IN HELIUM AND NEON
Murray Steinberg (Ph.D. Thesis) 1 Aug. 1968 90 p refs
(Contract W-7405-eng-48)
(UCRL-18387) Avail: CFSTI

A time-of-flight method for measuring the mean life of long-lived atomic states is described. The results of applying the method to the (1s2s) $^1S_0$ state in helium results in a measurement of a pressure-limited lifetime that leads to the conclusion that the lifetime must be greater than 9 msec. A tentative conclusion resulting from an application of the method to neon is that the $1s^2\ 2s^2\ 2p^5\ (^2P_{3/2}^{o})3s$ J = 2 state has a lifetime greater than 5 msec, while the $1s^2\ 2s^2\ 2p^5\ (^2P_{1/2}^{o})3s$ J = 0 state has a lifetime greater than 33 msec. Author (NSA)

N69-22651# International Atomic Energy Agency, Vienna (Austria).
NEUTRON INELASTIC SCATTERING, VOLUME 1
1968 627 p refs Partly in ENGLISH, FRENCH, and RUSSIAN
Fourth IAEA Symp., Copenhagen, 20–25 May 1968
(STI/PUB/187) Avail: CFSTI

Presented are various studies on inelastic scattering of neutrons in solids and liquids. Emphasis is placed on electron phonon interaction effects in lattice dynamics. For individual titles, see N69-22652 through N69-22709.

N69-22652# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
THE ROLE OF ELECTRONS IN PHONON SPECTRUM FORMATION IN METALS
Yu. M. Kagan and Ye G. Brovman *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 3–34 refs In RUSSIAN; ENGLISH summary (See N69-22651 11-24)
(SM-104/203) Avail: CFSTI

The explanation of phonon spectra in simple metals is based on long-range interaction between ions. A better description can be obtained if the electrons are included in the treatment. A theory based on the electron-ion system enables a better understanding of the indirect interaction between ions for a majority of non-transient metals. The physical and mathematical foundations are constituted, and the theoretical elaboration of this model is presented. The role of electrons in formations of the phonon spectra in metals is illustrated on examples of simple metals and metals with hexagonal structure. It is shown that the phonon spectra of complex metals could be satisfactorily explained by treating the short-range non-pair and the long-range pair interactions separately. Author

N69-22653# Atomic Energy Commission Research Establishment, Riso (Denmark).
LOCALIZED AND BAND PHONONS IN $Ta_{88}Nb_{12}$ STUDIED BY COHERENT INELASTIC NEUTRON SCATTERING
J. Als-Nielsen *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 35–42 refs (See N69-22651 11-24)
(SM-104/18) Avail: CFSTI

It is probable that substitution of Nb atoms in a Ta crystal does not alter the force constants significantly, so in a Ta–Nb alloy the Nb atoms can be regarded as nearly pure light-mass defects. These give rise to a localized mode of vibration with a frequency above the frequency band for pure Ta lattice vibrations. The lattice vibrations of an 88% Ta–12% Nb alloy have been studied by inelastic neutron scattering, using a triple-axis spectrometer in its constant-q mode of operation. In particular, the scattered intensity has been measured as a function of energy transfer, with q fixed along the (1, 0, 0) direction and perpendicular to the scattering vector. It has not been possible to resolve the band phonons from the localized phonon into two separate neutron energy groups. However, a tail at the high-energy side of the band phonon peak as well as an anomalous broadening of the peaks are interpreted as deriving from a localized mode of vibration. Its energy is 23.2 ± 0.2 meV, not far from the value of 22.55 meV calculated from the mass-defect theory using the frequency spectrum for Ta determined by Woods. The band phonons are shifted upwards in energy, although the dispersion curve becomes very flat or even decreases. A comparison between the neutron groups from the alloy and a pure Ta crystal is being initiated. Author

N69-22654# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
NORMAL MODES OF VIBRATION OF MIXED KBr/RbBr CRYSTALS
W. J. L. Buyers and R. A. Cowley *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 43–46 refs (See N69-22651 11-24)
(SM-104/42) Avail: CFSTI

Normal modes of vibration of crystals of KBr/RbBr containing 50 and 20 at. % of RbBr have been compared by neutron scattering with normal modes in KBr. In both the 20 and 80% crystals, normal modes were well defined. For the [111] LA branch, the decrease in frequency in going from pure KBr to both mixed crystals exhibited a dependence on wavevector characteristic of a resonance mode of frequency approximately 2.1 (10^{12} cps). The widths of the neutron groups were larger in the resonance region. Other modes did not show resonance behaviour. The frequencies of the [111] TA, [111] TO and [110] TA branches in the 80% crystal were less than those in KBr by an approximately constant

small amount; the shifts are 0.11 ± 0.06, 0.5 ± 0.1 and 0.16 ± 0.04 (10^{12}cps) respectively. There were no appreciable increases in the widths of the neutron groups from these modes. These results are compared with theoretical calculations based on mass defects from the mean lattice approximation. Author

N69-22655# Oak Ridge National Lab., Tenn.
COHERENT INELASTIC SCATTERING STUDY OF LOCAL AND IN-BAND MODES IN $Cu_{1-x}Al_x$ CRYSTALS
R. M. Nicklow, P. R. Visayaraghavan, H. G. Smith, G. Dolling, and M. K. Wilkinson *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 47–54 refs Sponsored by AEC (See N69-22651 11-24)
(SM-104/85) Avail: CFSTI

To investigate the influence of light-mass substitutional defects on the lattice dynamics of a crystal, the normal mode frequencies in copper crystals containing 4.1 and 10.0 atomic % aluminum have been measured by coherent inelastic neutron scattering experiments on a triple-axis neutron spectrometer located at the Oak Ridge High Flux Isotope Reactor (HFIR). The results for these crystals differ markedly in at least two respects from the results for pure copper. The disperions curves for the in-band modes fall significantly below those for pure copper, and an additional vibrational mode has been observed with a frequency higher than the maximum frequency in pure copper. This additional mode is interpreted as a local mode that corresponds to the vibrations of the light aluminum atom in the heavier copper matrix. To our knowledge this is the first observation of a local mode in a coherent neutron scattering experiment. Both the value and measured dependence of the neutron scattering cross-section for the local mode are in good agreement with calculations based on a simple mass-defect theory which assumes a low defect concentration and no force constant changes. However, the same theory fails to predict the measured changes of the in-band modes: significant decreases are observed rather than the small increases that are predicted. Author

N69-22656# National Bureau of Standards, Washington, D. C.
LOCALIZED MODES, RESONANT MODES AND IMPURITY VIBRATIONAL BANDS IN VANADIUM ALLOYS
B. Mozer *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 55–63 refs Supported in part by the AEC (See N69-22651 11-24)
(SM-104/78) Avail: CFSTI

Inelastic neutron scattering data have been obtained on several vanadium alloys using time-of-flight techniques. Localized impurity modes of vibration and a split impurity band have been observed in Be_xV_{1-x} alloys for $0.75 < x < 3.3$ at. %. The frequency of the localized mode observed in the lower concentration alloys occurs at about 0.047 eV, in agreement with the frequency predicted for a single isotopic impurity of the same mass ratio of beryllium to vanadium and using the experimental vanadium frequency distribution cut-off at 0.031 eV. As the concentration of beryllium is increased, the localized mode peak broadens and finally splits into two peaks at 3.3 at. % concentration of beryllium. Several theories of vibrational spectra of disordered alloys indicate structure in the impurity band; the theory favoured here for the explanation of our experiments is one that includes correlation of pairs of impurities. Assuming the observed splitting is caused by the proximity of another impurity, one finds the decay constant of the localized mode to be 2.5 a_0^{-1}. Inelastic neutron data were obtained on Ta_xV_{1-x}, W_xV_{1-x} and $Pt_{0.05}V_{0.95}$ alloys. None of the data for these alloys show peaks at the resonant mode frequencies expected for a single impurity or for resonant mode structure for a measurable concentration of impurities. An absence of resonant mode structure in our experiments and the small effects observed in experiments of other researchers indicate a more sophisticated theory is required which includes pair correlation of impurities and perhaps anharmonic effects. Author

N69-22657# Joint Inst. for Nuclear Research, Dubna (USSR).
LOCAL VIBRATIONS OF IMPURITY ATOMS IN COPPER AND LEAD
I. Natkaniec, K. Parlinski, J. A. Janik (Inst. of Nucl. Phys., Cracow), A. Basórek, and M. Sudnik-Hrynkiewicz *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 65–78 refs (See N69-22651 11-24)
(SM-104/34) Avail: CFSTI

The inelastic neutron scattering technique was applied in the determination of the energy of the local vibrations of light impurity atoms in the alloys: Cu-Be (42 ± 2 meV), Cu-Mg (34.5 ± 2 meV), Pb-Na (17 ± 1 meV), and Pb-Mg (16 ± meV). The structure of the samples examined was checked simultaneously by means of the elastic Bragg neutron scattering technique. For all alloys the energies of the local vibrations are lower than the values calculated assuming that the force constants of the impurity atom are equal to those of the host crystal. On the basis of the experimental values of the local vibration energy, the change in the force constants for the impurity atoms was estimated. Author

N69-22658# Academy of Sciences (USSR), Moscow. Inst. of Atomic Energy.
INVESTIGATION OF ADMIXED STATES IN VANADIUM ALLOYS
M. G. Zemlyano, S. P. Mironov, and G. F. Syrykh *In* IAEA Neutron Inelastic Scattering, vol. 1 1968 p 79–89 refs In RUSSIAN; ENGLISH summary (See N69-22651 11-24)
(SM-104/144) Avail: CFSTI

The results are given of research into quasi-local states caused by the introduction of different substitutional atoms of impurities into a vanadium metal crystal lattice. The results obtained are compared with theoretical calculations carried out using different model assumptions, and with results of experimental work done at other scientific centres. Research into inelastic scattering of cold neutrons is being done on an assembly at the IRT-M reactor. The spectral line of incident neutrons is established using a beryllium filter cooled by liquid nitrogen and a mechanical chopper. The energies of neutrons scattered at an angle of 90° are analysed at a distance of 4.5 m by the time-of-flight method. The excitation spectra for the systems studied, derived from the experimental results, are established with allowance for all necessary instrument corrections. Author

N69-22659# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
APPLICATION OF THE KREBS MODEL TO THE STUDY OF THE LATTICE DYNAMICS OF HEXAGONAL CLOSE-PACKED METALS
S. Hautecler and M. Neve de Mevergnies *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 91-99 refs (See N69-22651 11-24)
(SM-104/1) Avail: CFSTI

The physical content of the Krebs model, which was originally formulated for bcc and fcc metals, has been applied to hexagonal close-packed metals. The metal is considered as a set of spherical ions, of uniform charge distribution, embedded in an electron sea. The elements of the dynamical matrix have been deduced by assuming central spring interactions extending up to the sixth neighbours, and a screened Coulomb interaction between all ions. Six relations between the eight parameters introduced in the model and the five elastic constants have been obtained by the method of long waves. It is found that the lattice equilibrium condition obtained by equating the two expressions for C_{44} requires that the long-range interaction cancels out. It is concluded that the Krebs force model does not describe a crystal in equilibrium. If one wants to keep to the long-range term, the lattice is no longer

elastically consistent, which means that the calculated long wavelength limit for some branches of the dispersion relation in some directions is not correct. Author

N69-22660# Eidgenoessiches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland).
LATTICE DYNAMICS AND ELECTRONIC STRUCTURE OF SODIUM, MAGNESIUM AND ALUMINIUM
T. Schneider and E. Stoll *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 101–118 refs (See N69-22651 11-24)
(SM-104/4) Avail: CFSTI

The actual interaction between ions in a metal is divided into the direct interaction of the ion cores and the ion-electron-ion interaction. The ion-electron-ion interaction is treated according to the Hartree–Fock approximation, modified by a screened exchange potential. Since until now the bare ion potential has not been known very accurately, the observed phonon frequencies were used to determine a model pseudo-potential with the least-squares method. Using this model pseudo-potential, the electronic band structure, the Fermi surface, the cohesive energy, the crystal stability, the interactomic potential and the electrical resistivity were calculated. The method described enables us to relate the measured phonon dispersions with the electronic structure and the electrical properties of simple metals. Author

N69-22661# Chicago Univ., Ill.
MICROSCOPIC THEORY OF FORCE CONSTANTS IN SOLIDS
M. H. Cohen, R. M. Martin, and R. M. Pick *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 119–139 refs (See N69-22651 11-24
(SM-104/29) Avail: CFSTI

The expressions of the force constants are derived from the energy of a neutral system of interacting nuclei and electrons. These force constants depend only on the nuclear charges and the inverse dielectric function of the electronic system. We verify that they fulfill the general symmetry, translational and rotational invariance properties required by the Born-von Kármán theory. When the role of the core electrons is neglected, these force constants can be evaluated in metals from the bare ionic potentials. In insulators, the existence of long-wavelength acoustical phonons implies that the inverse dielectric function satisfies a certain number of sum rules. The method becomes more difficult to apply, which explains the general use of phenomenological models. Author

N69-22662# Cornell Univ., Ithaca, N. Y.
NEUTRONS, FREE ELECTRONS AND HIGH MAGNETIC FIELDS
R. A. Cowley *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 141–148 refs (See N69-22651 11-24)
(SM-104/47) Avail: CFSTI

The application of high magnetic fields to a material containing free electrons leads to a quantization into highly degenerate Landau levels. Blank and Kaner have shown that neutron scattering techniques can be used to study these levels through their influence on the phonon spectrum. When the phonon wavevector, $\vec{q}$, is parallel to the magnetic field, $\vec{H}$, a simple 'jellium' model shows logarithmic singularities in the phonon dispersion curves. However, it seems unlikely that these can be observed with presently available resolutions and magnetic fields. When $\vec{q}$ is perpendicular to $\vec{H}$, the model yields anomalies in the phonon dispersion curves at the cyclotron resonance frequencies; these anomalies should be observable. Calculations are presented for the case of potassium. Neutron scattering techniques may also be used to study the magnetic scattering. The form factor for the elastic scattering is very dependent on the Fermi surface diameter. The inelastic scattering shows anomalies similar to those of the phonon spectrum. Calculations are presented for a free electron model of a nearly ferromagnetic material. Author

N69-22663# Oak Ridge National Lab., Tenn.
PHONON DISPERSION CURVES IN LITHIUM
H. G. Smith, G. Dolling, R. M. Nicklow, P. R. Vijayaraghavan, and M. K. Wilkinson *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 149–155 refs (See N69-22651 11-24)
(SM-104/86) Avail: CFSTI

Phonons have been measured in several high-symmetry directions in Li^{17} metal by coherent inelastic neutron scattering. Most of the measurements were made at 98°K (well above the Martensitic transition at 78°K) on the triple-axis spectrometer at the HRIF. The results indicate that the interatomic forces in lithium are of a longer range than in sodium or potassium; for example, the sixth-neighbor force constants based on a general model are 12% of the first neighbor force constants. The frequency distribution and Debye versus temperature relation have been calculated. Author

N69-22664# Polish Academy of Sciences, Swierk (Poland). Inst. of Nuclear Research.
PHONON DISPERSION RELATIONS IN BISMUTH
J. Sosnowski, S. Bednarski, and A. Czachor *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 157–164 refs (See N69-22651 11-24)
(SM-104/132) Avail: CFSTI

Phonon dispersion relations in bismuth at room temperature have been studied by neutron inelastic scattering using a triple-axis neutron crystal spectrometer and the constant-Q method. The fixed wavelength $\lambda_0 = 1.50$ Å was used. K_0 was kept fixed and K_1, the scattering angle ϕ and the crystal orientation were varied to realize the 'constant-Q' mode of operation. The principles of focusing were used throughout the measurements. The plane of the experiment was the $(01\bar{1})$ plane. The phonon dispersion relations for the [100], [110], and [211] and [111] directions have been obtained. The dispersion relations for the [111] direction are compared with those obtained by Yarnell et al. Special care was devoted to the study of dispersion relation for the [100] direction where, according to Ovchinnikov's calculations, an anomaly connected with electron-phonon interaction can be expected. The experimental curves are compared with the calculated ones based on the Born-von Kármán theory. Author

N69-22665# Joint Inst. for Nuclear Research, Dubna (USSR).
THEORY OF VIBRATIONAL SPECTRUM IN HEXAGONAL METALS
Ye. G. Browman, Yu. M. Kagan, and A. Kholas *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 165–179 refs In RUSSIAN; ENGLISH summary (See N69-22651 11-24)
(SM-104/145) Avail: CFSTI

The previously developed general theory of vibrational spectrum in metals, based on separation of the long and short-range interionic interactions in the electron-ion system, is applied to the analysis of the phonon spectrum in the hexagonal metals Be, Mg and Zn. The long-range interaction is demonstrated with help of the concrete form of the pseudo-potentials in these metals, while the parameters of the short-range interaction are determined from some experimental quantities. The essential role of the short-range interaction is demonstrated. A detailed comparison of theory with experiment is given. Author

N69-22668# Japan Atomic Energy Research Inst., Ibaraki.
LATTICE DYNAMICS OF Cu_{1-x}–Ni_x
M. Sakamoto and Y. Hamaguchi *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 181–186 refs (See N69-22651 11-24)
(SM-104/24) Avail: CFSTI

The phonon dispersion relations for the (110) direction in the alloy $Cu_{0.9}$–$Ni_{0.1}$ and pure copper have been measured by inelastic scattering of slow neutrons using the time-of-flight spectrometer at the 10–MW research reactor JRR–2. The measurements were made at room temperature. There are significant differences in the shapes of the dispersion curves for $Cu_{0.9}$–$Ni_{0.1}$ as compared with the results for Cu. Those of $Cu_{0.9}$–$Ni_{0.1}$ show large anomalies in the range of reduced wave number q = 0.5 tl 1.1 for both 1 and T_2 branches. This is in contrast to the very smooth behavior on the dispersion curves for copper and nickel. The range of the forces of interaction was determined by performing least-squares fits of the experimental dispersion relations for Cu and $Cu_{0.9}$–$Ni_{0.1}$ to Fourier series. For $Cu_{0.9}$–$Ni_{0.1}$ seven planes at least are needed to fit the observed dispersion curves in both branches, as compared with three planes needed to obtain a reasonable fit for Cu. This indicates that the force constants between distant neighbors for alloys are larger than those for Cu. Author

N69-22667# Aktiebolaget Atomenergi, Studsvik (Sweden).
OBSERVATIONS OF THE KOHN EFFECT IN COPPER
G. Nilsson *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 187–194 refs (See N69-22651 11-24)
(SM-104/40) Avail: CFSTI

The dispersion relations for phonons in copper have been investigated by neutron spectrometry in regions where the Kohn anomalies are expected to be large, and where simultaneously the phonon frequencies can be determined with good instrumental resolution. Phonon frequencies are obtained with estimated errors of 0.2%, apart from a possible systematic error. Anomalies have been observed, and they may be interpreted in terms of several points in the central (2,2,0) section of the Fermi surface, in agreement with determinations by other methods. As is expected from earlier experiments and theoretical predictions, the Kohn effect in copper is weak. Careful measurements and analysis are necessary to make the anomalies observable with the techniques now available. Author

N69-22668# Bhabha Atomic Research Center, Bombay (India).
KOHN ANOMALIES IN ZINC
P. K. Iyengar, G. Venkataraman, Y. H. Gameel, and K. R. Rao *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 195–201 refs (See N69-22651 11-24)
(SM-104/124) Avail: CFSTI

The dispersion relations in zinc have been measured along two symmetry directions. The phonon frequencies are in qualitative agreement with those of Borgonovi et al. Screening effects of the conduction electrons on the frequencies of normal vibrations of zinc are known to be large and hence electron phonon interaction is strong in this metal. The frequencies of lattice modes are fairly low, hence one could expect to see the images of the Fermi surface in the dispersion relations even at room temperature. The results are in agreement with these predictions. An interpretation of the observed Kohn anomalies is made on the basis of the geometry of the Fermi surface in zinc. Author

N69-22669# Kernforschungsanlage, Juelich (West Germany).
LATTICE DYNAMICS OF PLATINUM
R. Ohrlich and W. Drexel *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 203–209 refs (See N69-22651 11-24)
(SM-104/66) Avail: CFSTI

The energy/wave vector relations of phonons in the 100 and 110 planes of the reciprocal lattice of platinum have been determined by inelastic neutron scattering at room temperature. The measurements have been performed by the time-of-flight technique using the rotating crystal spectrometer and the pseudo-statistical chopper at the FR2 reactor. The measured dispersion relations have been fitted with a Born-von Kármán model using up to fifth-nearest neighbors. From these data the frequency distribution has been generated with the sampling technique and used for the calculation of various thermodynamic quantities. Author

N69-22670# McMaster Univ., Hamilton (Ontario).
LATTICE DYNAMICS OF RUBIDIUM
J. R. D. Copley, B. N. Brockhouse, and S. H. Chen (Waterloo Univ., Ontario) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 209–214 refs (See N69-22651 11-24)
(SM-104/54) Avail: CFSTI

The frequency/wave vector dispersion relation for the normal modes of vibration in the major symmetry directions of body-centered cubic rubidium has been measured at 120°K. The large ($\approx$75 cm^3) single crystal was aligned with either a [110] or a [100] axis vertical, and constant incident frequencies between 3.8 and 5.5 × 10^{12} c/s were employed. The measurements were taken with a triple-axis spectrometer in the constant-$\vec{Q}$ mode of operation. The dispersion curves are similar to those of sodium and potassium. The ratio $\langle \nu(k,9°K)/\nu(Rb, 120°K) \rangle$ for a set of 104 values of $\vec{q}$ common to both sets of data, is 1.667 ± 0.005 with a standard deviation for an individual ratio from the mean of 0.05. The homology of the lattice vibrations for Na and Rb is poorer than for K and Rb. A Born-von Kármán analysis of the measurements has been made, and it is found that third nearest neighbor forces must be included to obtain reasonable agreement. More distant neighbor forces improve the fit relatively little. Axially symmetric constraints do not change the force constants significantly. As expected, the force constant 1XY is larger than 1XX, which suggests that the forces between nearest neighbors are repulsive. The initial slopes of the dispersion curves are considerably larger than the slopes deduced from ultrasonic measurements. Author

N69-22671# Cambridge Univ. (England) Cavendish Lab.
MEASUREMENTS OF FREQUENCIES OF NORMAL MODES OF MAGNESIUM
R. Pynn and G. L. Squires *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 215–222 refs (See N69-22651 11-24)
(SM-104/120) Avail: CFSTI

The investigation of the phonon dispersion relations in magnesium has been continued, and the frequencies of over 1500 phonons with wave vectors in the (10$\bar{1}$0) plane have been measured on the DIDO reactor. The velocity spectra of inelastically scattered slow neutrons have been analyzed by the time-of-flight method. The wave vectors of the measured phonons are distributed throughout the plane. An interpolation method was used to obtain the dispersion relations in several directions, including those principal symmetry axes which lie in the plane. The results are compared with a simple theoretical model. Author

N69-22672# European Atomic Energy Community, Ispra (Italy).
THE DYNAMICS OF HYDROGEN IMPURITIES IN NIOBIUM AND VANADIUM
G. Verdan, R. Rubin, and W. Kley *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 223–231 refs (See N69-22651 11-24)
(SM-104/128) Avail: CFSTI

The inelastic scattering of cold neutrons in single crystals of vanadium hydride and niobium hydride revealed local modes at E_1V = 167 ± 6 meV, E_2V = 123 ±6 meV and E_1Nb = 177 ± 6 meV, E_2Nb = 114 ± 6 meV. From a measurement of the

width function of hydrogen in polycrystalline niobium, the diffusion constant $D(200^{\circ}C) = 2 \times 10^{-15}$ cm^2/sec and the time between diffusive jumps $\tau = 1.3 \times 10^{-12}$ sec could be determined. Author

N69-22673# Reactor Centrum Nederland, Petten.
LATTICE DYNAMICS OF Alpha-Fe AND Fe_3Al
C. Van Dijk and J. Bergsma *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 233-243 refs (See N69-22651 11-24)
(SM-104/137) Avail: CFSTI

Detailed measurements of the phonon dispersion relations in alpha iron have been made at room temperature using the triple axis crystal spectrometer at the HFR reactor at Petten. Over 200 modes, observed at regular distances in the [ζ00], [ζζ0], [ζζζ], [ζζ1] and [1/2-1/2ζ] directions, are presented. An analysis in terms of the Born-von Kármán theory, using a linear least-squares method, shows that for getting qualitative agreement with experiment it is sufficient to take into account forces out to third neighbors only, but for reproducing the details of the dispersion relations, forces out to fourth and fifth neighbors have also to be included. An interesting feature, also confirmed by other recent measurements on α-Fe, is the attractive force between first neighbors manifested in $\alpha_1 > \beta_1$. Based on this model the phonon frequency distribution has been calculated. In addition, phonon measurements on the closely related ion-aluminum alloy Fe_3Al in the ordered phase are reported. The structure of Fe_3Al consists of four interpenetrating fcc lattices and can be derived from the α-Fe structure by replacing every fourth atom along the [111] direction by aluminum. The close relation between the lattice dynamics of α-Fe and Fe_3Al becomes much clearer when the α Fe data are described according to the lattice. Author

N69-22674# Kernforschungsanlage, Juelich (West Germany).
INELASTIC NEUTRON SCATTERING ON SOLID AND LIQUID TELLURIUM AND SELENIUM
W. Gissler, A. Axmann and T. Springer *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 245-252 refs (See N69-22651 11-24)
(SM-104/12) Avail: CFSTI

Inelastic scattering experiments have been performed on crystalline and liquid selenium and tellurium and on amorphous selenium using a rotating crystal and a triple-axis spectrometer. The experiments on selenium polycrystals and tellurium poly- and single crystals show high-energy modes which can be identified as intra-chain bond stretching modes with a pronounced molecular vibrational character. There are further optical modes at lower energies due to bond-shearing vibrations and to torsional modes of the chains against each other. The results are consistent with infrared experiments. No reliable check of the existing theories has been possible, but a rough agreement was found. Comparing the spectra of polycrystalline, amorphous, and liquid selenium, there is no appreciable shift or broadening of the peaks ascribed to optical intra-chain modes in the amorphous and liquid phase. The influence of small admixtures of iodine has been studied which reduces the length of the chains. For liquid tellurium at 470°C there are no peaks at all in the spectrum which results from a breakdown of the polymeric structure. The change of the quasi-elastic line width with the chain length was found to be considerably smaller than the change of the reciprocal viscosity. Author

N69-22675# McMaster Univ., Hamilton (Ontario).
ATOMIC VIBRATIONS IN FACE-CENTERED-CUBIC ALLOYS OF Bi, Pb and Tl
J. C. Ng and B. N. Brockhouse *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 253-266 refs (See N69-22651 11-24)
(SM-104/53) Avail: CFSTI

The atomic vibrations in the alloy systems Bi-Pb-Tl have been studied at 100°K, over a wide range of electron concentrations by inelastic neutron scattering. Six binary alloys and one ternary have been investigated. The dispersion curves for these alloys show a progressive change with electron concentration. The main features of the dispersion curves for pairs of alloys having the same electron concentrations are quite similar. The variation of the frequencies with electron concentration indicates that the electron-phonon coupling strength increases with increasing electron concentration. Analysis of the dispersion curves based on Born-von Kármán theory shows that long-range forces extending beyond the eight neighbor exist. However, distant neighbor interactions appear to become smaller as the electron concentration in the alloy systems is reduced. The dispersion curves for some of the alloys are believed to show Kohn anomalies similar to those observed in Pb. From these anomalies, diameters of the Fermi surface along the [110] and [111] directions have been deduced for the Pb-Tl alloys. The results are consistent with the rigid band model. The neutron groups observed in the alloys are in general reasonably sharp and well-formed. The broadening of the neutron groups has been attributed to the force constant disorder in the alloys. A theoretical discussion based on perturbation theory is given. The widths involve products of pairs of deviations (of the force constants from their mean values) and hence are relatively insensitive to force constant order. Author

N69-22676# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
NEUTRON SCATTERING NEAR THE FERROELECTRIC TRANSITION IN KD_2PO_4
W. J. L. Buyers, R. A. Cowley, G. L. Paul (Edinburgh Univ., Scotland), and W. Cochran (Edinburgh Univ., Scotland) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 267-274 refs (See N69-22651 11-24)
(SM-104/48) Avail: CFSTI

In the paraelectric phase of single-crystal KD_2PO_4 coherent quasi-elastic neutron scattering has been observed, the magnitude of which increases greatly as the transition temperature (−49.6°C) is approached. There is no evidence for a well-defined mode with frequency falling to zero at the transition temperature. The quasi-elastic intensity is strong near reciprocal lattice points such as (3,0,1), 3,0,3), and (2,0,4) but weak near (0,0,2), (2,0,0), (2,0,2), and (4,0,2). The structure factor is consistent with the displacements of the ions at the phase transition in KDP. The scattering is therefore associated with collective atomic fluctuations in which a dipole moment is produced along the ferroelectric axis. The energy width of the scattering from the fluctuations is less than 0.2×10^{12}cps. The intensity at (3,15,0.3), neglecting any correction for resolution, exhibits Curie law behavior with $T_0 = -59.4$°C. In contrast, the lowest frequency phonons observed do not show any strong temperature dependence. The relevance of these results to various models for the ordering of the deuterium atoms in the phase transition is discussed. Author

N69-22677# Edinburgh Univ. (Scotland).
A CORRELATION FUNCTION FOR PHONON EIGENVECTORS
W. Cochran *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 275-280 refs (See N69-22651 11-24)
(SM-104/121) Avail: CFSTI

It was shown by van Hove that the Fourier transform of the neutron scattering intensity is a space-time correlation function of the scattering density. In the special case of a single crystal as the scattering system, the coefficients of a Fourier series can be derived from the one-phonon scattering cross-sections corresponding to a phonon of a particular frequency. Evaluation of the Fourier series gives a space correlation function involving the eigenvectors of the mode of vibration being considered. The function is a special

case of the van Hove function, closely related to the Patterson function which is used in X-ray crystallography. In the special case of a phonon of wave vector zero ($q = 0$) the function has a sufficiently simple interpretation that it may be of practical value.
Author

N69-22678# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
NEUTRON SCATTERING AND ELASTIC CONSTANTS
R. A. Cowley, W. J. L. Buyers, C. Svensson, and G. L. Paul (Edinburgh Univ., Scotland) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 281–288 refs (See N69-22651 11-24)
(SM-104/46) Avail: CFSTI

Elastic constants of crystals obtained from neutron scattering techniques at frequencies, ω, of the order of 10^{12} cps, are frequently compared with those obtained with ultrasonic techniques for which $\omega < 10^{10}$ cps. If the normal modes of vibration of the crystal did not interact with each other or with other excitations in the crystal, these elastic constants would be identical. In a real crystal, however, interactions exist, and these lead to different behavior, depending on whether the elastic wave propagates in a collision-free, $\omega\tau >> 1$, mode or a collision-dominated $\omega\tau << 1$, manner, where τ is the life-time of a typical phonon. In anharmonic crystals phonon-phonon interaction introduces a life-time so that elastic waves are expected to behave differently at high and low frequencies. Experiments on both KBr and $SrTiO_3$ have demonstrated this difference. In piezoelectric crystals τ is related to the time required for the electric polarization to follow the elastic wave. At frequencies so high that the electric polarization cannot follow the elastic wave, experiments on DKDP have shown that the elastic constants do not exhibit the anomaly present at low frequencies. Similar behavior is expected to occur near many phase transitions which show anomalous elastic behavior. Analogous, but probably smaller, effects occur through the interactions of elastic waves with conduction electrons in metals and with the spins in magnetic materials.
Author

N69-22679# Commissariat a l'Energie Atomique, Saclay (France).
STUDY OF THE DYNAMICS OF THE LATTICE OF A MgF SUB 2 MONOCRYSTAL BY INELASTIC NEUTRON SCATTERING [ETUDE DE LA DYNAMIQUE DU RESEAU DE MGF SUB 2 PAR DIFFUSION INELASTIQUE DE NEUTRONS]
R. Kahn, J. P. Trotin, D. Cribier, and C. Benoit *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 289–293 refs In FRENCH (See N69-22651 11-24)
(SM-104/33) Avail: CFSTI

By analyzing the inelastic neutron scattering in a MgF_2 monocrystal with a triple-axis spectrometer, the phonon dispersion relations were determined. This study was made to prove the calculation of the two-phonon process for the infrared and Raman spectra.
Author

N69-22680# Aktiebolaget Atomenergi, Nykoping (Sweden).
PHONON DISPERSION RELATIONS IN NaCl AT 80°K
L. Almquist, G. Raunio, and R. Stedman *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 295–299 refs (See N69-22651 11-24)
(SM-104/41) Avail: CFSTI

Measurements on sodium chloride are in progress, using one of the neutron spectrometers with two-crystal monochromators which have recently begun to operate at the R2 reactor in Studsvik. Although lattice vibrations in sodium chloride might be termed one of the classical problems of solid state theory, experimental examination with neutrons is hampered by the considerable absorption and incoherent scattering and the difficulty of obtaining a large high-quality crystal. However, an almost complete set of phonon dispersion curves has now been determined, and these may be compared with the curves calculated by Karo and Hardy (1966) for their most sophisticated model (deformation dipole, next-nearest neighbors included). There are significant differences almost everywhere at the higher frequencies. The 'breathing shell' model of Schröder gives a better fit.
Author

N69-22681# Los Alamos Scientific Lab., N. Mex.
LATTICE DYNAMICS OF GALLIUM PHOSPHIDE
J. L. Yarnell, J. L. Warren, R. G. Wenzel, and P. J. Dean (Bell Telephone Labs., Murray Hill, N. J.) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 301–313 refs (See N69-22651 11-24)
(SM-104/75) Avail: CFSTI

Dispersion curves for phonons propagating in the [100], [110], and [111] directions in gallium phosphide have been measured using a triple-axis neutron diffraction spectrometer operating in the constant-Q mode. The sample was a pseudo-single crystal prepared by gluing together 36 single crystal plates 1 to 2.5 cm in diameter and $\approx$ 0.07 cm thick. The plates were grown epitaxially on substrates of gallium arsenide or gallium phosphide and aligned individually by neutron diffraction. Rocking curves for eight reflections symmetrically distributed in the plane of the experiment had full widths at half maximum in the range 0.52°–0.58° and were approximately Gaussian in shape. Gallium phosphide crystallizes in the zinc blende structure. A group theoretic analysis of the lattice dynamics of this structure and a shell model fit to the measured dispersion curves are presented. Optical properties of gallium phosphide are discussed in terms of the phonon dispersion curves. In particular, the phonons which assist indirect electronic transitions are identified as those at the zone boundary in the [100] direction (symmetry point X) in agreement with theoretical and experimental indications that the extrema of the conduction and valence bands are at X and Γ (center of the zone), respectively. The LO branches lie above the TO branches throughout the Brillouin zone. The shell model fit indicates that the charge on the gallium atom is negative.
Author

N69-22682# Idaho Nuclear Corp., Idaho Falls.
PHONON DISPERSION RELATION OF BERYLLIUM OXIDE
G. L. Ostheller, R. E. Schmunk, R. M. Brugger, and R. J. Kearney *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 315–324 refs Sponsored by AEC (See N69-22651 11-24)
(SM-104/93) Avail: CFSTI

Measurements for BeO have been extended by neutron inelastic scattering, using the MTR triple-axis spectrometer. New data include a transverse acoustic branch and an optical branch with wave propagation in the [01$\bar{1}$0] direction and in addition the transverse acoustic, longitudinal acoustic and a transverse optic branch, all with wave propagation in the [0001] direction. The two optical branches observed are degenerate at the center of the Brillouin zone with a frequency $\omega = 8.21 \pm 0.11 \times 10^{13}$ rad/sec. This frequency is in fair agreement with the optical data of Loh which gives $\omega = 8.41 \times 10^{13}$ rad/sec for the same mode. From the neutrons scattering data of this experiment and the optical data of Loh it appears that the low-lying optical branches reported previously by Brugger et al are not single phonon data but are the result of multiphonon processes. The measured branches of the dispersion relation and the results of preliminary lattice dynamics model calculations are compared.
Author

N69-22683# United Kingdom Atomic Energy Authority, Harwell (England).
THE PHONON DISTRIBUTION OF GRAPHITE AT HIGH TEMPERATURES
D. I. Page *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 325–338 refs (See N69-22651 11-24)
(SM-104/109) Avail: CFSTI

The phonon spectrum of graphite is notable for the high energy of some of its modes. The cutoff in the frequency distribution is about 0.22 eV (2500°K), and it is difficult to measure accurately the whole of the distribution by neutron scattering experiments on samples at room temperature. Raising the temperature of the sample, however, increases the probability of high energy gains by the neutron. The inelastic scattering of slow neutrons by graphite at 1800°K was therefore measured using a phased rotor spectrometer. Energy transfers covering the whole range of the frequency distribution were observed with clearly defined peaks. The results were compared with theoretical predictions and show good agreement. The incoherent approximation is shown to be reasonably valid at this high temperature, and a smoothed frequency distribution is given, which allows the calculation of scattering cross sections in agreement with data measured at other temperatures. Author

N69-22684# Iowa State Univ. of Science and Technology, Ames.
LATTICE DYNAMICS OF HCP He SUP 4 BY INELASTIC NEUTRON SCATTERING
T. O. Brun, S. K. Sinha, C. A. Swenson, and C. R. Tilford *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 339–344 refs (See N69-22651 11-24)
(SM-104/146) Avail: CFSTI

Phonon dispersion curves were measured along the c axis of the reciprocal lattice of hcp He^4 using a triple axis neutron spectrometer. The measurements were made on a single crystal of He^4 at a molar volume of 16.03 cm^3 and oriented in the 1120 plane. The measurements compared with various theoretical calculations, some of which predict frequencies about 20% lower than those resulting from experiment, while other predictions are too high by about the same amount. The results also indicated that while the acoustic modes for small wave vector show well defined neutron groups, the large wave vector and optic modes show considerable broadening, indicating strong lifetime effects. Author

N69-22685# Picatinny Arsenal, Dover, N. J.
LATTICE DYNAMICS OF HYDROGEN-BONDED CRYSTALS
S. Trevino, H. Prask, T. Wall, and S. Yip (MIT) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 345–365 refs (See N69-22651 11-24)
(SM-104/101) Avail: CFSTI

A mathematical procedure is outlined by which the dynamical equation of harmonic solids can be generally written in terms of central and noncentral forces. Two systems, H_2O and HCl, are chosen for illustration. The dynamical properties of these two crystals are calculated and compared with optical and neutron spectroscopic data. A limited success was obtained in reproducing the data for ice, and good results were obtained for HCl. The assignments resulting from the present investigation are discussed and further work is indicated. Author

N69-22686# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
PRESSURE DEPENDENCE OF THE FREQUENCY OF SOME PHONONS IN SODIUM IODIDE
G. Quittnak, S. Vukovich, and G. Ernst *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 367–372 refs (See N69-22651 11-24)
(Contract AF 61(052)-638)
(SM-104/123) Avail: CFSTI

Results of measurements on the pressure induced phonon frequency shifts of some phonons of the LA and the TA branches in sodium iodide crystals are presented. A hydrostatic pressure of 3000 atm was applied. Some special features and problems of the measurement and evaluation of frequency shifts are briefly discussed. The results are compared to previous Grüneisen parameter calculations based on a shell model. Author

N69-22687# Comitato Nazionale per l'Energia Nucleare, Ispra (Italy).
PHONON-PHONON INTERACTIONS IN ZINC
G. Caglioti, G. Ilizzi, and G. Cubiotti (Messina Univ., Italy) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 373–378 refs (See N69-22651 11-24)
(SM-104/138) Avail: CFSTI

Experimental results on the shape of phonon peaks in the neighbourhood of the point of accidental degeneracy of the longitudinal acoustic and transverse optic branches polarized in the basal plane of zinc were recently obtained with the purpose of investigating anharmonic contributions to the potential energy for the nuclei motions. The study was limited to room temperature, and continuing attempts are being made to obtain adequate instrumental resolution. At the time of the experiment it appeared to be impossible to exclude a slight extra broadening of the phonon lines at ω and q values barely smaller than those corresponding to the point of degeneracy. Work is continuing to extend the investigations to higher and possibly lower temperatures. Author

N69-22688# Kent Univ., Canterbury (England). Physics Lab.
NUCLEAR MAGNETIC RESONANCE IN LIQUIDS AND SOLIDS
J. G. Powles *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 379–394 refs (See N69-22651 11-24)
(SM-104/204) Avail: CFSTI

The basic principles of nuclear magnetic resonance (nmr) are outlined, and the method is compared and contrasted where possible with that of slow neutron scattering as a technique for studying the properties of condensed phases, and particularly of molecular and atomic motions. This review is aimed at providing the reader with a primary interest in neutron scattering with some appreciation of the scope and limitations of the nmr method. Author

N69-22689# Royal Inst. of Tech., Stockholm (Sweden).
LIQUID DYNAMICS FROM NEUTRON SCATTERING
K.-E. Larsson *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 397–429 refs (See N69-22651 11-24)
(SM-104/200) Avail: CFSTI

A review is presented on recent investigations using slow neutron scattering techniques. For simple liquids, the only new data appear to be for liquid lead and argon, although attempts to calculate the mean square displacement for an atom in liquid sodium on the basis of a given pair potential have been made and the data compared with neutron results. The existence order in a simple liquid in space and time seems to be more firmly established. For complex liquids, more progress in understanding neutron results has been made; models have been created and theories formulated which take the translational and rotational molecular motions into account. In particular, the motion of one of the simplest molecular liquids, methane, has been studied and the scattered spectrum is relatively well understood as a hindered rotation combined with a vibrational and diffusive motion of the molecular center of gravity. The nature of the quasi elastic neutron scattering also appears to be better understood, and the connection between this method and results obtained by other methods is more firmly established, particularly between infrared and Raman spectroscopy and neutron spectroscopy. A possible connection with dielectric, ultrasonic, and nmr data is also indicated. Author

N69-22690# Helsinki Univ. (Finland).
PHONONS IN LIQUID BISMUTH STUDIED BY NEUTRON INELASTIC SCATTERING
E. Tunkelo, R. Kuoppamaeki, and A. Palmgren *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 431–437 refs (See N69-22651 11-24)
(SM-104/27) Avail: CFSTI

Scattering in liquid and solid polycrystalline bismuth was studied using 5 MeV neutrons incident on the sample and scattering angles ranging from 7.5° to 30°. The liquid sample temperature was 280°C and the solid sample 262°C; and similar peaks were observed in the scattered intensity for both, which were attributed to the coherent one phonon scattering. This led to construction of a (ω,q) relation similar to a dispersion curve, averaged over all possible directions of wavevectors. Both transverse and longitudinal branches of the acoustic modes were observed in the liquid as well as in the polycrystalline solid. Dispersion curves obtained for the liquid are similar to those of the solid, but the frequencies of the longitudinal branch are about 65% of those of the solid. This value is equal to the ratio of the sound velocities in both liquid and solid bismuth. The intensity distribution of the scattered neutrons was analyzed, and it is shown that the peaks can be attributed to single phonon excitations, while contributions from higher Brillouin zones do not produce disturbing peaks. From this calculation it was further concluded that the angle between the polarization vectors of the transverse modes and the direction of propagation varies in the region of 70° to 110°. Author

N69-22691# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.

MOLECULAR DYNAMICS IN LIQUID NITROGEN AND LIQUID BISMUTH INVESTIGATED BY COLD NEUTRON SCATTERING

N. Mateescu, H. Teutsch, A. Diaconesu and V. Nahorniak *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 439–447 refs (See N69-22651 11-24)

(SM-104/58) Avail: CFSTI

The neutron scattering law for liquid nitrogen at 77.4°K and liquid bismuth at 560°K was determined using a beryllium filter and time-of-flight technique. The scattered neutron spectra at scattering angles between 15° and 90° for liquid nitrogen and 60° and 90° for liquid bismuth were measured. After making the necessary corrections for multiple scattering, the results were compared with several theoretical models. In the quasi elastic range, the best agreement was obtained with the effective mass model. For liquid nitrogen, it was necessary to introduce the contribution of rotational diffusion. In the inelastic range, the dispersion law of quasi phonons for both liquids was determined according to an established quasi crystalline model. Author

N69-22692# Idaho Nuclear Corp., Idaho Falls.

INELASTIC SCATTERING IN LIQUID SODIUM AT SMALL MOMENTUM TRANSFER

P. D. Randolph *In* IAEA Neutron Inelastic Scattering, Vol. 1968 p 449–456 refs Supported by AEC

(SM-104/84) Avail: CFSTI

The small momentum transfer region in simple liquids is of particular interest from the standpoint of examining the approach to the hydrodynamic limit and for studying diffusive and collective excitations. Measurements are reported on the inelastic scattering of slow neutrons from a sample of liquid sodium at 102°C in the x region below the first diffraction maximum. The experiment was performed with a phased chopper velocity selector at incident energies of 30 and 51 MeV. To remove air scattering, an evacuated flight path subtending an 18.3° range of scattering angles was used. The quasielastic scattering was analysed after correction for coherent scattering and multiple elastic scattering. The behavior is solid-like with a Debye–Waller coefficient of 0.22 $Å^2$. The widths of the quasielastic peaks are narrower than predicted by the simple diffusion model, but are in agreement with the jump diffusion model with a residence time τ_0 of 1.5×10^{-12}sec. A broad peak or shoulder in the inelastic scattering appearing in all scattering angles at an energy transfer of 14 MeV is primarily due to incoherent inelastic scattering. Its shape is in agreement with a Debye frequency spectrum but beyond the cutoff shows evidence of multiple inelastic scattering. Author

N69-22693# State Univ. of New York, Stony Brook.

TEMPERATURE DEPENDENCE OF QUASI-ELASTIC SCATTERING OF COLD NEUTRONS FROM LIQUID ARGON

W. S. Andrus, H. R. Muether, and H. Palevsky (Brookhaven Natl. Lab., Upton, N. Y.) *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 457–462 refs Supported by AEC (See N69-22651 11-24)

(SM-104/97) Avail: CFSTI

A variety of scattering angles and sample temperatures were used on a slow chopper facility to perform the measurements. A full beryllium filtered incident spectrum was used to obtain time-of-flight spectra, and the quasi elastic width was extracted by comparing the data to numerically generated spectra. The temperature dependence of the quasi elastic peak at each angle was inconsistent with the free diffusion hypothesis. The data were compared to previous predictions of coherent scattering from liquids to ascertain their validity. Author

N69-22694# United Kingdom Atomic Energy Authority, Harwell (England).

A QUASI-PHONON TREATMENT OF COHERENT NEUTRON SCATTERING BY LIQUID LEAD

S. J. Cocking *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 463–473 refs (See N69-22651 11-24)

(SM-104/115) Avail: CFSTI

Two treatments which employ a phonon type description of the relative motions of atoms in liquids were compared. The first method introduces the concept of finite range of the excitation, while the second takes some account of polarization of the modes. It is shown that the introduction of polarization is required to explain the observed results of coherent neutron scattering by liquid metals, in agreement with previous theories for liquid argon. Detailed comparison of a previous theory with experimental results on liquid lead required assumption of the spectral density of both the longitudinal and transverse modes. Resulting calculations showed a relative amount of agreement with established experimental results. Author

N69-22695# Aktiebolaget Atomenergi, Nykoping (Sweden).

DIFFUSIVE MOTIONS IN BENZENE AND TOLUENE STUDIED WITH SLOW NEUTRONS

S. Holmryd and G. Nelin *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 475–482 (See N69-22651 11-24) refs

(SM-104/38) Avail: CFSTI

Inelastic scattering experiments of slow neutrons have been performed on the two substances using a time-of-flight spectrometer for cold neutrons with an energy resolution of 12%. The quasi-elastic scattering has been studied for small momentum transfer as a function of temperature. Diffusion coefficients have been determined assuming a Lorentzian cross section. The temperature dependence of the diffusion coefficient for benzene follows an exponential law, but the coefficient is a few times larger than the macroscopic coefficient, showing that a large amount of rotational diffusion exists. For toluene there is a change in the temperature dependence of the coefficient at about the Arrhenius temperature (T_A). This is taken as an indication of a change in the number of degrees of rotational freedom of the toluene molecule around T_A. The methyl group in toluene has a low barrier to rotation. Therefore, the hindered rotation levels of the methyl group, as well as molecular rotation, will contribute significantly to the inelastic scattering spectrum which overlaps the quasi-elastic peak. The inelastic component is subtracted by extrapolation, but the possible contribution of the CH_3 rotation to the quasi-elastic peak itself is neglected. Author

N69-22696# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.

INELASTIC SCATTERING OF THERMAL NEUTRONS BY SOME BENZENE DERIVATIVES

V. Trepadus, D. Bally, V. A. Parfenov, and V. G. Liforov *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 483–490 refs (See N69-22651 11-24)

(SM-104/58) Avail: CFSTI

Thermal neutron scattering in phenol, hydroquinone, and pyrogallol in the liquid state was investigated. The E_0 energy of incident neutrons was varied between 15 and 50 meV and the scattering angles between 5° and 108°. The quasi-elastic maximum width of scattered neutron spectra was determined. The obtained and computed values were compared by the Larsson–Bergstedt method. Very good agreement was obtained between the experimental and theoretical data. The result obtained can be explained by the contribution at the quasi-elastic maximum of neutron interactions with rotational oscillatory motion around an axis contained within a molecular plane. This interpretation can be justified by comparing our results with those obtained in the i.r. spectrum of benzene. The transition corresponding to a wave number of approximately 80 cm^{-1} was observed in the quasi-elastic scattered neutron spectra of all substances studied; it was ascribed to molecular rotational oscillation around an axis contained within the molecule plane. The observed maxima in the three spectra corresponding to the wave numbers, 434 cm^{-1} (phenol), 412 cm^{-1} (hydroquinone) and 463 cm^{-1} (pyrogallol), are ascribed to superposing of the OH group vibration motions and benzenic ring deformation. A third maximum can be observed for hydroquinone and pyrogallol, corresponding to a wave number 150 cm^{-1}, characteristic for the hydrogen bond. Author

N69-22697# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.

THERMAL NEUTRON INELASTIC SCATTERING BY METHYL ALCOHOL AND METHYL MERCAPTAN

T. E. Sampson and J. M. Carpenter *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 491–499 refs Supported by NSF. (See N69-22651 11-24)

(SM-104/89) Avail: CFSTI

Thermal neutron inelastic scattering spectra of room temperature methyl alcohol (CH_3OH) and methyl mercaptan (CH_3SH) in the liquid state are reported. The principal feature of the spectra of both liquids is the narrow quasi-elastic peak prominent at low momentum transfers which merges into a broad band of energy transfers, extending to energies greater than 100 meV at larger momentum transfers. For momentum transfers in the range 1–6 $Å^{-1}$ the spectra for CH_3SH have a greater width than those for CH_3OH. This is attributed to the effect of the strong hydrogen bonding in CH_3Oh which hinders both the rotation and translation of the methanol molecule, whereas hydrogen bonding in methyl mercaptan is believed to be quite weak. Measurements of the quasi-elastic line widths for small momentum transfers are also presented. No prominent maxima are found in the inelastic spectra for either material. For CH_3OH a broad band of energy transfers in the range from 60–100 meV is attributed to the O-H out-of-plane deformation frequency. There is some evidence to support several weak events of under 20 meV. For CH_3SH there is also a broad high-energy band between 70 and 110 meV, and the possibility of weak events in the low-energy region exists. Author

N69-22698# Academia R. P. R., Bucharest. Institutul de Fizica Atomica.

STUDY OF THE SOLID-LIQUID TRANSITION IN CYCLOHEXANE BY COLD NEUTRONS

V. Tarina *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 501-506 (See N69-22651 11-24) refs

(SM-104/59) Avail: CFSTI

Measurements of total cross section and double-differential cross sections versus temperature for cyclohexane below and above the melting point were performed. The incident wavelength for total cross section was 10.2Å, while the double-differential cross sections were measured using Be-filtered neutrons. The temperature was varied continuously between −20 and +20°C. A thermostat which kept the temperature constant to a precision better than ±0.05°C was used. The following problems are considered: (1) the comparison of the measured total cross section of solid cyclohexane with that calculated for polycrystals; (2) determination of the Debye temperature for liquid cyclohexane; (3) the evaluation of a disorder entropy at the melting point transition; and (4) the existence of a homophase premelting in the melting process of cyclohexane. Author

N69-22699# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

THE DYNAMICS OF LIQUID HYDROGEN OXIDE AND DEUTERIUM OXIDE AND SOLID HYDROGEN OXIDE FROM THE INELASTIC SCATTERING OF EPITHERMAL NEUTRONS

O. K. Harling *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 507–523 refs (See N69-22651 11-24)

(Contract AT(45-1)-1830)

(SM-104/80) Avail: CFSTI

An extensive series of neutron inelastic scattering measurements has been made on liquid H_2O and D_2O at 299°K and on solid H_2O at 268°K. Double differential cross sections for H_2O were obtained for energy transfers to 0.6 eV and momentum wave vector transfers to 32 $Å^{-1}$, while for D_2O the energy and momentum transfer range was 0.2 eV and 9.5 $Å^{-1}$, respectively. All measurements were obtained with the Battelle rotating crystal spectrometer, using initial neutron energies of 0.101 to 0.818 eV. Scattering angles ranged from 15 to 155°. The measured differential cross sections exhibit considerable structure in energy corresponding to the torsional motions and the intramolecular bending and stretching modes of the H_2O molecule. Instrumental resolution was adequate to obtain information about the width of some of these transitions. In the case of the measurements on ice, the angular dependence of the inelastic scattering from the torsional band was determined. The experimental differential cross section for excitation of these modes is found to be in good agreement with the angular dependence calculated for inelastic scattering from a symmetric harmonic oscillator potential. Spectral density functions for the proton and deuteron were obtained using an extrapolation technique. These density functions extend to higher energy transfers than previously published neutron results, and include the intramolecular bending modes of the water molecule. Author

N69-22700# Joint Inst. for Nuclear Research, Dubna (USSR).

SELF-DIFFUSION COEFFICIENT OF ETHANE NEAR THE LIQUID-GAS TRANSITION POINT

L. A. Bulavin, A. V. Voronel, Yu. M. Ostanevich, A. P. Simkina, and A. V. Strelkov *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 525–533 refs In RUSSIAN (See N69-22651 11-24)

(SM-104/142) Avail: CFSTI

The diffusion coefficient of small amounts of impurities in a pure substance is sharply reduced in the neighborhood of the liquid-gas transition point. Attempts were made to observe similar alterations in the self-diffusion coefficient near the transition point of ethane by using cold neutron quasi-elastic scattering. The IFR reactor and an arrangement consisting of a beryllium filter in front of a detector were used for the measurements. With an increase of the sample temperature, no changes greater than 0.03 meV were observed in the quasi-elastic line width. Thus, no significant changes were found in the self-diffusion coefficient near the liquid-gas transition point in the pure substance. A final evaluation

is given for the upper limit of changes in the self-diffusion coefficient, with corrections for multiple scattering, final angular resolution, etc. Author

N69-22701# Cornell Univ., Ithaca, N. Y.
COLLECTIVE MODES IN LIQUIDS AND NEUTRON SCATTERING
M. Nelkin and P. J. Ortoleva *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 535–544 refs (See N69-22651 11-24)
(Contract AT(30-1)3326)
(SM-104/73) Avail: CFSTI

Using linear response theory and the fluctuation-dissipation theorem, G(r,t) for a classical fluid is expressed in terms of the solution of the Liouville equation with a precisely defined initial condition. The special form taken by the s-particle distribution functions at zero time is essential in identifying the non-equilibrium problem studied with the particular equilibrium fluctuation of direct interest in neutron scattering. A simple approximation which exhibits many of the observed collective features of neutron scattering data is a linearized Vlasov equation with the interatomic potential replaced by -kT times the direct correlation function, c(r). Calculations in this approximation illustrate the importance, for interpreting neutron scattering data, of solving the relevant initial value problem rather than considering dispersion relations for the collective modes. In this approximation the direct solution of the initial value problem for S(Q,ω) is straightforward. Comparisons with molecular dynamics results are presented. Author

N69-22702# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF NEUTRON SCATTERING EXPERIMENTS ON LIQUIDS
A. K. Agrawal, R. C. Desai, and S. Yip *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 545–559 refs (See N69-22651 11-24)
(SM-104/104) Avail: CFSTI

The influence of atomic and of molecular motions on the spectrum of inelastically scattered neutrons is analyzed in terms of classical correlation functions. In the case of incoherent scattering, the approach is based on the use of a Gaussian intermediate scattering function and a means square displacement, which for a molecular system consists of seperate translation and rotation components. An interpolation model which gives the correct behavior at short and long times is used to describe the center-of-mass motions. This model has no adjustable parameters if the mean square force and the diffusion coefficient are known. The rotational effects are treated through an angular correlation function which can be calculated for a gas of spherical, linear, and symmetric molecules. For liquids the function is obtained from the Fourier transform of an infrared vibration band. For coherent scattering the interpolation model is used in conjunction with the effective-mass approximation, which is an improvement over the Vineyard convolution approximation in that the second moment sum rule is now satisfied. The analysis is applied to recent experiments on liquid argon, sodium, lead, methane and hydrogen in liquid argon. Comparison is made in terms of the differential cross section (on an absolute scale) and of the variation of quasi-elastic peak width with momentum transfer. The general conclusion is that the interpolation model, the effective-mass approximation, and the angular correlation functions obtained from infrared data (in the case of methane) permit all the qualitative features observed in the neutron experiment to be obtained. Author

N69-22703# Argonne National Lab., Ill.
CURRENT FLUCTUATIONS IN CLASSICAL LIQUIDS
A. Rahman *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 561-572 (See N69-22651 11-24) refs Sponsored by AEC
(SM-104/95) Avail: CFSTI

Molecular dynamics data on an argon-like liquid are used to determine the spectrum of current density fluctuations in the system. It is found that for a given wave number, the frequency spectra of the longitudinal and the transverse current fluctuations have a well-defined peak. The position of this peak depends on the wave number, and, for the longitudinal currents, the dependence is closely related to the structure factor of the system; for transverse currents the dependence is less marked. Estimates of the lifetimes of the fluctuations are obtained from the shape of the spectra. The unique role of molecular dynamics for the study of transverse current correlations is discussed. Author

N69-22704# United Kingdom Atomic Energy Authority, Harwell (England).
THE THEORY OF HIGH-FREQUENCY DENSITY FLUCTUATIONS IN LIQUIDS
P. Schofield *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 p 573–580 refs (See N69-22651 11-24)
(SM-104/135) Avail: CFSTI

A theory is presented which attempts to explain the close similarity observed, particularly in metals, between the neutron scattering in a polycrystal just below the melting point and in the liquid just above the melting point, for frequencies greater than that characterizing the basic diffusive mechanism. The starting point is an approximation to the equivalent of the one-phonon cross-section in the solid. Successive approximations are discussed, leading finally to a quasi-harmonic approximation. This reduces the problem to the solution of a pair of coupled integral equations involving the two and three particle equilibrium distribution functions. For a crystalline solid at low temperature these equations correctly give the phonon dispersion laws. The form of the equations indicate a qualitative agreement with the experimental results. In particular, the strong angular correlation of two particles relative to a third at small separations is shown to give an effect similar to that of the orientational averaging in the one-phonon cross-section for a polycrystal, and to lead to the appearance of transverse excitations in the scattered neutron spectrum. Author

N69-22705# Royal Inst. of Tech., Stockholm (Sweden).
NEW RESULTS ON QUASI-ELASTIC SCATTERING FROM SOME HYDROGENOUS LIQUIDS
U. Dahlborg, B. Friberg, K.-E. Larsson and E. Pirkmajer *In* IAEA Neutron Inelastic Scattering, Vol. 1 1968 1 581–597 refs (See N69-22651 11-24)
(SM-104/38) Avail: CFSTI

A study of the quasi-elastic scattering of cold neutrons from pentane and pentanol by use of the inverted filter technique is reported. The total energy resolution of the spectrometer in this investigation was varied from 0.10 to 0.13 meV at the beryllium oxide cut-off. It is found that the total quasi-elastic cross-section is made up of two components, a narrow central peak and a broader underlying part. From their intensity variation, it is concluded that the narrow peak is of an elastic nature while the broader underlying distribution has an inelastic origin. The width of the central peak for liquid pentane and for pentanol in the low viscosity region is understood from measured or extrapolated translational diffusion constants, while for lower temperatures another diffusion mechanism, probably rotational diffusion, is responsible for the width. A comparison is made with results obtained from two time-of-flight spectrometers, using the cold spectrum to define the energies of the neutrons hitting the sample. It is found that both of the two components observed in the inverted filter investigation are included in the quasi-elastic peak. Both the width dependence and the intensity dependence of the wave number can be fully reproduced by an appropriate sum of the new results. The quasi-elastic peak

is thus probably of a true almost elastic origin, as well as of an inelastic origin. It is concluded that very high resolution both on the monochromator and on the analyzer side is required to reveal the true nature of the near elastic neutron scattering spectra. Author

N69-22706# Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerper und Neu Tronenphysik.
BRILLOUIN SCATTERING OF NEUTRONS FROM LIQUID CO
K. Mika, B. Dorner, and H. H. Stiller. *In* IAEA. Neutron Inelastic Scattering, Vol. 1. 1968 p 599–607 refs (See N69-22651 11-24)
(SM-104/115) Avail: CFSTI

The energy distributions of neutrons scattered from liquid and from solid β-CO are measured with a triple-axis spectrometer. Multiple scattering is largely suppressed by inserting a Cd honeycomb into the sample. In solid β-CO, longitudinal phonons are observed in this way: Their dispersion, averaged over all lattice directions, is determined; the longitudinal sound velocity is found to be 1500 m/sec. In liquid CO, a large amount of small energy transfers is observed, probably resulting from a large difference between the isothermal and the adiabatic compressibility. Energy width is discussed in terms of diffusion, free rotations and hydrodynamics. It is shown that diffusion makes only a small contribution. The scattering due to free or quasi-free rotations is calculated in the Krieger–Nelkin approximation. After subtracting this contribution from the experimental inelastic data, Brillouin peaks are again well separated. From their position, a dispersion law for longitudinal phonons in liquid CO can be derived, with a sound velocity of 1200 m/sec. Author

N69-22707# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
HIGH-ENERGY EXCITATIONS IN LIQUID HELIUM
A. D. B. Woods and R. A. Cowley. *In* IAEA. Neutron Inelastic Scattering, Vol. 1. 1968 p 609–614 refs (See N69-22651 11-24)
(SM-104/45) Avail: CFSTI

The scattering of neutrons from liquid helium at 1.1°K has been studied by use of a rotating crystal spectrometer and a triple-axis crystal spectrometer. Measurements were made at both larger energy and momentum transfers than in earlier experiments where the existence of phonons and rotons was demonstrated. An additional ill-defined excitation branch was found at momentum transfers, Q, of less than 2Å^{-1}. Its intensity was comparable with that of the phonon branch; its mean energy was almost constant at about 24°K, and its full-width at half height was approximately equal to its energy. At larger momentum tranfers, the mean energy of this excitation increased, and, above 3Å^{-1}, was almost the free particle energy. The width of this scattering increased, on average, linearly with Q, up to the limit to the measurements, 9Å^{-1}, and in magnitude was consistent with an independent particle model and McMillan's ground state wave function of liquid helium. Additional structure was also observed in the width, possibly arising from the creation of vortex rings. Author

N69-22708# Hungarian Academy of Sciences, Budapest.
INVESTIGATION OF THE DYNAMICAL PROPERTIES OF LIQUID-GAS SYSTEMS BY COHERENT COLD NEUTRON SCATTERING NEAR THE CRITICAL POINT
I. Bata and N. Kroo. *In* IAEA. Neutron Inelastic Scattering, Vol. 1 1968 p 615–622 refs (See N69-22651 11-24)
(SM-104/10) Avail: CFSTI

Inelastic coherent neutron scattering was chosen because of the relatively higher momentum transfers involved for the investigation of the dynamic behavior of liquids in the critical region where $Q\lambda >> 1$. The critical state of the CO_2 and CS_2 samples was first confirmed by elastic cold neutron scattering measurements, carried out at small angles. The scattered intensities at fixed angles as a function of temperature exhibited maxima at the critical point due to density fluctuations. To study the dynamics of these fluctuations, inelastic neutron scattering measurements were performed in a wide angular region, keeping the values of Q_{el} smaller than that of the first diffraction peak and varying the temperature from room temperature to critical and higher. The results are explained in terms of the hydrodynamic approximation at small momentum transfer, as due to scattering by isobaric and adiabatic density fluctuations, characteristic of the dynamics of the critical state. Author

N69-22709# Catholic Univ. of America, Washington, D. C.
RELAXATION SPECTROSCOPY IN LIQUIDS
C. J. Montrose and T. A. Litovitz. *In* IAEA. Neutron Inelastic Scattering, Vol. 1. 1968 p 623–637 refs (See N69-22651 11-24)
(SM-104/201) Avail: CFSTI

The interrelationships among various relaxation processes are explored. The observed distributions of dielectric relaxation times can be accounted for by assuming that the ultrasonically determined structural relaxation time characterizes the environmental memory of a molecule in the liquid and is therefore a rate-determining step in the dielectric relaxation process. The ratio of dielectric to structural relaxation times is the critical parameter in determining the width of the dielectric distribution. This same idea is used to relate the magnitudes of the dielectric relaxation time and the relaxation time associated with depolarized Rayleigh scattering, to the nature of the molecular reorientation mechanism in a liquid. Molecular reorientation is assumed to proceed by a series of angular steps. It appears that in a liquid the structural relaxation time plays a role analogous to the time between collisions in a gas, insofar as it gives the basic environmental correlation time, fundamental to all the diffusional motions of a molecule. Author

N69-22710# International Atomic Energy Agency, Vienna (Austria).
NEUTRON INELASTIC SCATTERING, VOLUME 2
1968 471 p refs Partly in ENGLISH, FRENCH, and RUSSIAN Fourth IAEA Symp., Copenhagen, 20–25 May 1968
(STI/PUB/187-VOL-2) Avail: CFSTI

In the papers presented, attention was focused on magnetic systems, molecular dynamics, and experimental methods. For individual titles, see N69-22711 through N69-22750.

N69-22711# Atomic Energy Commission Research Establishment, Riso (Denmark).
NEUTRON SPIN SCATTERING BY SPIN WAVES IN METALS
H. Bjerrum Moller. *In* IAEA. Neutron Inelastic Scattering, Vol. 2 1968 p 3–27 refs (See N69-22710 11-24)
(SM-104/205) Avail: CFSTI

This study is concerned with magnetic metals. In the rare earth metals such studies have given rather detailed information on the indirect exchange interaction and its relation to the electronic structure. Measurements on the iron group metlas have so far given much less information, and no effects which show unambiguously the itinerant character of the magnetic electrons have been observed, probably because spin-wave studies in iron group metals have only been possible for rather low wave vectors of the spin waves. Author

N69-22712# Atomic Energy Commission Research Establishment, Riso (Denmark).
MAGNON ENERGIES AND EXCHANGE INTERACTIONS IN TERBIUM
J. C. Gylden Hollmann *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 29–35 refs (See N69-22710 11-24)
(SM-104/17) Avail: CFSTI

The magnon density of states, and hence the magnetic contribution to the specific heat, together with the exchange interaction between ions in the same sub-lattice have been calculated for Tb at 90°K, using experimental results obtained by inelastic neutron scattering. An interpolation method was used to determine the magnon energies throughout the Brillouin zone from magnon dispersion relations that were previously obtained. Author

N69-22713# Hungarian Academy of Sciences, Budapest.
VIRTUAL MAGNON STATES IN DILUTE ALLOYS
N. Kroo, L. Pal, and D. Jouic (Inst. of Nuclear Sci., Belgrade)
In IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 37–44 refs (See N69-22710 11-14)
(SM-104/7) Avail: CFSTI

The effect of magnetic impurity atoms on the spin wave spectrum of Fe and Ni has been studied with inelastic neutron scattering using the time-of-flight method. If weakly bound magnetic impurity atoms are randomly distributed in a ferromagnetic crystal, incoherent magnetic neutron scattering occurs with a resonance at the energy of the virtual level. From the width of this resonance the lifetime of the virtual state and from the energy the impurity-host to host-host exchange energy ratio can be determined. The magnetic origin of the observed resonance can be proved by repeating the measurements on magnetized samples. In a Fe matrix the effects of Mn, Er, V, and Cr atoms were studied. In Fe(Mn) an anomalous broad resonance was observed at $E_0 \sim 20$ MeV. The angular distribution of the total scattered intensity has a maximum, indicating that $S_{Mn} \neq 0$ and that the density distribution of magnetic electrons of iron atoms near the Mn impurity has changed. In Fe(Er) and Fe(Cr) low-lying virtual levels were observed, with 0.6 MeV and 1.6 MeV energies, respectively. The results in Ni(V) and Ni(Cr) are also described. In Fe(V) a virtual level could not be seen in the observed scattered neutron spectra. The temperature dependence of the lifetime of the observed resonances was also studied between 80°K and the Curie point. Author

N69-22714# Institutt for Atomenergi, Kjeller (Norway).
INELASTIC SCATTERING OF POLARIZED NEUTRONS BY MAGNETO-VIBRATIONAL WAVES IN A SINGLE CRYSTAL OF bcc IRON
O. Steinsvoll *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 45–54 refs (See N69-22710 11-24)
(SM-104/64) Avail: CFSTI

It has been predicted theoretically that the scattering of neutrons by magneto-vibrational waves in a magnetic crystal should depend upon the polarization state of the incoming neutrons. Measurements were made to confirm the theoretical expressions for the polarization effects. The widths of the inelastic diffuse reflections obtained by the diffraction method have been found to agree with the linear dispersion relation of phonons, and the velocity of sound agrees with values found by other types of measurements. A direct proof has been given by using a flipper-chopper time-of-flight spectrometer that the polarization effects are connected with inelastic scattering processes. The different field and polarization dependence of the magneto-vibrational and spin wave scattering has been used to resolve the scattering components present in the composite diffuse reflections. In principle, it is then possible to find values of the magnetic form factor for the ions for momentum transfers different from the reciprocal lattice vectors, and some preliminary results are presented of this new method. Author

N69-22715# Hungarian Academy of Sciences, Budapest.
NEUTRON SCATTERING INVESTIGATION OF THE DYNAMICS OF THE CRITICAL STATE IN IRON
J. Gordon, Eva Kisdi-Koszo, L. Pal and I. Vizi *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 55–62 refs (See N69-22710 11-24)
(SM-104/9) Avail: CFSTI

The inelasticity of critical scattering has been investigated in iron using the pulsed monochromatic neutron beam at the IBR-1 reactor in Dubna. The measurement covered the temperature range $-2.5 \times 10^{-3} \leq \tau \leq 6.5 \times 10^{-3}$ where $\tau = T/T_c - 1$ and the critical temperature was approached within $\tau < 5 \times 10^{-4}$. The slight temperature dependence of the inelasticity was confirmed for $q = 5.7 \times 10^{-2}$ Å^{-1}, but the observed diffusion constant was found to be temperature independent and higher ($\mu = 16.5$) than the value ($\mu = 11$) reported earlier by other authors. Author

N69-22716# Atomic Energy Commission Research Establishment, Riso (Denmark).
INELASTIC CRITICAL NEUTRON SCATTERING IN TERBIUM
O. W. Dietrich and J. Als-Nielsen *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 63–74 refs (See N69-22710 11-24)
(SM-104/21) Avail: CFSTI

The critical neutron scattering above the Néel temperature T_N in Tb has been measured using both double-axis and triple-axis spectrometry. The parameters of the magnetic susceptibility and the spin relaxation function have been deduced in the temperature range $0.005 \leq (T-T_N)/T_N \leq 0.06$. Both the inverse correlation range κ_1, and the long wavelength susceptibility $\chi(\vec{0})$ obey temperature power laws, with the exponents $\nu = 0.66 \pm 0.02$ and $\gamma = 1.33 \pm 0.02$, respectively. The results for the relaxation function show that thermodynamic slowing down of the spin fluctuations does occur in Tb when the temperature approaches the critical temperature. Author

N69-22717# Academia R.P.R., Bucharest. Inst. for Atomic Physics.
SMALL-ANGLE CRITICAL MAGNETIC SCATTERING OF NEUTRONS IN Co
D. Bally, M. Popovici, M. Totia, D. Grabcev, and A. M. Lungu *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 75–82 refs (See N69-22651 11-24)
(SM-104/55) Avail: CFSTI

Angular distributions of the small-angle critical scattering of 1.25 Å neutrons in cobalt have been measured at temperatures up to 150°C above the Curie point for a large range of scattering vectors ($\kappa = 0.03$–0.6 Å^{-1}). The experimental data show that the asymptotic form of the instantaneous spin pair correlation function at large distances is that predicted by Fisher. The temperature dependence of the interaction range inferred from experimental data is in agreement with theoretical predictions. The exponents of the temperature dependences of the reduced magnetic susceptibility and correlation range are found to be smaller in cobalt than in iron. The critical scattering data are in agreement with classical susceptibility measurements. The angular distributions at relatively large values of the scattering vector show the limited validity of the asymptotic spin correlation function. The variation with κ of the position of the maximum scattered intensity as a function of temperature is discussed. Author

N69-22718# United Kingdom Atomic Energy Authority, Harwell (England).
SPIN CORRELATIONS IN ONE, TWO AND THREE-DIMENSIONAL HEISENBERG PARAMAGNETS

C. G. Windsor *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 83–92 refs (See N69-22710 11-24)
(SM-104/112) Avail: CFSTI

The spin correlations $< \vec{S}_0(0)\cdot\vec{S}_n(t) >$ within a finite lattice of several thousand classical spins have been calculated by solving numerically the equation of motion of an initially random set of spins interacting through nearest-neighbor Heisenberg exchange interactions. Previous results on a simple cubic lattice have been extended to include all neighbors with separations up to three lattice spacings. The Fourier transformation over space and time to give the wave vector and frequency dependent scattering function may now be made to within a resolution in frequency of order $2JS/\hbar$. This function is closely related to the neutron scattering cross section involving a momentum transfer $\hbar q$ and an energy transfer $\hbar\omega$, and the calculations are compared with experimental measurements on a single crystal of $RbMnF_3$. Since the Hamiltonian of this salt is well known, this comparison may be made on an absolute scale without further parameters. Similar calculations with a square lattice in two dimensions and with a linear chain have proved rather easier to compute with accuracy, on account of the smaller number of neighbors which contribute appreciably to the correlations within a given time. The results for a linear chain are compared with quantum mechanical calculations on a linear chain of ten spin half-particles. Author

N69-22719# Atomic Energy Commission Research Establishment, Riso (Denmark).
LINE SHAPE OF THE MAGNETIC SCATTERING FROM ANISOTROPIC PARAMAGNETS
P. A. Lindgard *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 93–99 refs (See N69-22710 11-24)
(SM-104/19) Avail: CFSTI

The frequency dependence of the cross section for magnetically scattered neutrons for low-energy transfer ($\hbar\omega << kT$) is conventionally expressed by $F^{\alpha\beta}(\vec{\kappa},\omega)$, the Fourier transform of the normalized relaxation function. The second and fourth moments with respect to ω of $F(\vec{\kappa},\omega)$ have been evaluated in the high-temperature limit for anistropic materials described by a Hamiltonian containing Heisenberg interaction and axial anisotropy. A discussion, using the moments and the Gram-Charlier expansion, is given of the frequency dependence of $F(\vec{\kappa},\omega)$. Significant deviations are to be expected from the Gaussian line shape at large κ values and from the Lorentzian line shape at small κ values and at high temperatures. The results are compared with exact Ising model calculations and with measurements in the paramagnetic phase of rare earth metals, experimentally determined exchange and anisotropy parameters being used. As a first-order temperature correction, it is taken into account that the moments are proportional to $T/\chi(\vec{\kappa},T)$, where $\chi(\vec{\kappa},T)$ is the wavelength dependent susceptibility. Author

N69-22720# United Kingdom Atomic Energy Authority, Harwell (England).
MAGNETIC EXCITATIONS IN NICKEL
S. Komura, R. D. Lowde, and C. G. Windsor *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 101–110 refs (See N69-22710 11-24)
(SM-104/110) Avail: CFSTI

The Fourier transform of the spin correlation function $(\vec{S}_0 \vec{S}_n(t))$ has been measured by means of neutron scattering, and its evolution studied as the temperature is carried through the order-disorder transition point from the low to the high-temperature extreme situations. The correlation is exhibited in detail over the complete Brillouin zone for the range of energies up to 0.11 eV at 0.9, 0.9, 1.1, and 1.8 times T_c. At the highest temperature the distribution is well explained by the elementary theory of Gamer paramagnetism if an exchange enhancement calculated in random-phase approximation is introduced. At low temperature the correlation shows a sharp ridge corresponding to spin-wave excitations; below 80 MeV the spin-wave peaks all fall close to a parabola extrapolated from the quadratic dispersion law of previous low-energy determinations, but at higher energies they fall away from this parabola. As the temperature is taken through the phase-transition point, critical enhancement of the susceptibility such as would be predicted using the random-phase approximation is not observed. The approach to criticality from either side is characterized instead by a pronounced anticipation of the features of the susceptibility on the other side of the Curie point. Away from a region closely confined to the origin, the transition through T_c is smooth; indeed the correlation functions at 0.9 T_c and 1.1 T_c are strikingly similar. In the critical region the susceptibility is dominated by spin-wave-like peaks rather than paramagnons; it is suggested that the explanation might lie in the existence of large fluctuations of the band splitting near T_c. Author

N69-22721# Hungarian Academy of Sciences, Budapest.
SPIN WAVES AROUND THE NEEL TEMPERATURE IN MnO
N. Kroo and L. Bata *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 111–115 refs (See N69-22710 11-24)
(SM-104/8) Avail: CFSTI

The spin wave spectrum has been investigated in antiferromagnetic MnO by inelastic scattering of cold neutrons using the time-of-flight method. No abrupt change was found in the spectrum during the phase transition. The average lifetime of magnons is a monotonical function of the temperature even around T_N = 125°K. In the 110°–125°K range the average energy change of scattered neutrons at a fixed angle decreases with increasing temperature. In the same temperature range an additional high intensity coherent elastic peak is to be seen with a κ value half that of the [111] antiferromagnetic super-reflection. It is known from classical and neutron diffraction data that the extraordinary temperature anomaly in the heat capacity and the disappearance of the rhombohedral distortion of the crystal occur also in the range from 110° to 125°K. The comparison of measured time-of-flight spectra at $T < T_N$ and $T > T_N$ clearly shows the existence of collective spin-excitations in the paramagnetic phase. Author

N69-22722# Reactor Centrum Nederland, Petten.
EXCHANGE INTEGRALS IN MAGNETITE
K. T. Moeglestue *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 117–122 refs (See N69-22710 11-24)
(SM-104/63) Avail: CFSTI

The values of the three average nearest-neighbor magnetic exchange integrals in magnetite have been calculated based upon the results of Brockhouse and Watanabe, Alperin et al., and Dimitrijević et al. Brockhouse and Watanabe measured the energy of the acoustic magnons at the zone boundary in the [001] direction by means of a triple-axis neutron spectrometer. They also found the energy of the lowest optic magnons for zero wave vector. For small magnon wave vectors, $\vec{q}$, the theoretical expression for the acoustic branch may be expanded in powers of $\vec{q}$. Using the 'diffraction method', Alperin et al. and Dimitrijević et al. measured the coefficient of the quadratic term, a_2, of this expansion. The result of the present calculation is $J_{AA} = -1.52 \pm 0.48$ MeV, $J_{AB} = -2.42 \pm 0.04$ MeV and $J_{BB} = 0.31 \pm 0.07$ MeV. Here J_{AA}, J_{AB} and J_{BB} are the average magnetic exchange integrals between nearest neighbor A–A ions, A–B ions, and B–B ions respectively. This result has been compared to earlier determination of J_{AB} and J_{BB} where it was assumed that J_{AA} vanishes. The conclusion of this comparison is that all three exchange integrals should be taken into account on interpreting spin-wave data on magnetite. The exchange integrals J_{AA} and J_{BB} have been studied as a function of a_2. It has been found that

J_{BB} is almost independent of a_2, while J_{AA} exhibits a very strong dependence on it. Based upon the present investigation, the complete spin-wave dispersion curve has been computed for the [001] direction. There is a good agreement between the computed curve and the experimental points. Author

N69-22723# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MAGNETIC EXCITATIONS IN COBALTOUS OXIDE
W. J. L. Buyers, G. Dolling, J. Sakurai, and R. A. Cowley *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 123–131 refs (See N69-22710 11-24)
(SM-104/44) Avail: CFSTI

Neutron inelastic scattering experiments on single crystal cobalt oxide showed that magnetic excitations exist both above and below the transition temperature (293°K). The measurements were made with a triple axis crystal spectrometer. In the paramagnetic phase, two distinct bands of excitations were observed, which correspond to transitions between the spin-orbit levels of the Co^{2+} ion. The ratio of the measured transition frequencies (0.61) and the temperature dependence of the intensities of the bands support this assignment. The spin-orbit coupling parameter is only 40% of the free-ion value, possibly because of a dynamic Jahn–Teller effect. Two bands of excitations were also observed in the antiferromagnetic state, but their origins were believed to be quite different from those described above. They correspond, respectively, to transitions from the ground state of the Co^{2+} ion to its conjugate state and to the lowest state of the next spin-orbit level. At the temperature of the experiment (110°K), the latter transition is the lower of the two transitions at approximately $5(10^{12}$ cps). Both transitons exhibit weak dependence on wave vector. A spin wave model for these magnetic excitations led to a next-nearest-neighbour exchange constant of 0.35 ± 0.02 (10^{12} cps), and indicated that the nearest-neighbour exchange constant and the tetragonal distortion are both small. The transition temperature of this model in the molecular field approximation is 240°K, in reasonable agreement with experiment. Author

N69-22724# Eidgenoessiches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).
PARAMAGNETIC SCATTERING OF NEUTRONS BY TRIVALENT RARE-EARTH IONS IN AN OCTAHEDRAL CRYSTAL FIELD
A. Furrer, W. Haelg, and T. Schneider *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 133–139 refs (See N69-22710 11-24)
(SM-104/5) Avail: CFSTI

The energy distribution of neutrons scattered by trivalent rare earth compounds was measured at room temperature. The paramagnetic lines, corresponding to transitions within the ground state multiplet of the rare earth ion split by the octahedral crystal field, are superposed on the nuclear parts of the energy distribution. Experimental conditions and computational methods are described to determine the position and shape of the paramagnetic lines. The resulting values of the crystal field splitting and the paramagnetic line width are discussed. Author

N69-22725# Joint Inst. for Nuclear Research, Dubna (USSR).
INVESTIGATION OF THE DYNAMICS OF WATER MOLECULES IN CRYSTALLO-HYDRATES BY NEUTRON INELASTIC SCATTERING
A. Bajorek, J. A. Janik, J. M. Janik, I. Natkaniec, K. Parlinski et al *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 143–158 refs (See N69-22710 11-24)
(SM-104/143) Avail: CFSTI

Translatory and rotatory frequencies of crystallization molecules of water were determined by the neutron inelastic scattering method in several crystallohydrates. The results are compared with those obtained from infrared and nuclear magnetic resonance experiments. Author

N69-22726# Michigan Univ., Ann Arbor.
DISPERSION RELATION FOR SKELETAL VIBRATIONS IN DEUTERATED POLYETHYLENE
L. A. Feldkamp, G. Venkataraman, and J. S. King *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 159–165 refs (See N69-22710 11-24)
(Grant NSF GK-1943)
(SM-104/70) Avail: CFSTI

Dispersion relations were obtained directly by observing the coherent scattering from a deuterated sample. This represents the first such measurement on a crystalline polymer. A target in which the molecular chain axes were approximately parallel was prepared by stretching polycrystalline material. Constant-Q and constant-E scans were made on a triple axis spectrometer at room temperature to observe phonons propagating along the chain direction. The resulting disperaion curve for the ν_5 mode follows generally a previously calculated curve for systematically lower frequencies. The maximum frequency of 1.36×10^{13} Hz agrees with the cutoff frequency determined previously from the incoherent scattering spectrum. Author

N69-22727# Michigan Univ., Ann Arbor.
FREQUENCY DISTRIBUTIONS OF SYNDIOTACTIC POLYVINYLCHLORIDE
J. E. Lynch, Jr. and G. C. Summerfield *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 167–173 refs (See N69-22710 11-24)
(SM-104/74) Avail: CFSTI

The incoherent neutron scattering cross section was determined from a set of frequency distributions for a harmonic crystal, using previously established force constants introduced for the saturated hydrocarbons. A diagonal torsional force constant of 0.06 mdyn $Å/rad^2$ is also included, while intermolecular forces, except for an ϵ^2 dependence in frequency distributions at small ϵ, are excluded. Representative calculations to indicate the necessary resolution for determining the details of the frequency spectra are also presented. Author

N69-22728# Gulf General Atomic, San Diego, Calif.
AN INVESTIGATION OF POLYPEPTIDE, POLY-L-GLUTAMIC ACID, USING NEUTRON INELASTIC SCATTERING
W. L. Whittemore *In* IAEA Neutron Inelastic Scattering Vol. 2 1968 p 175–184 refs (See N69-22710 11-24)
(SM-104/76) Avail: CFSTI

Experiments at room temperature were conducted using polyglutamic acid in the α helix conformation, as well its complex side chain which contributes a number of natural frequencies essentially independent of conformation. In the first measurements, cold neutrons from a reactor were used to investigate the energy level structure up to $\simeq$ 3 kT for both conformations of the polymer. In addition, the scattering of monoenergetic high energy neutrons provided by an electron linear accelerator was used to study energy levels above 3 kT. These latter measurements permit comparisons to be made between the calculated and measured results for a much larger range of frequencies. This extension of the experimental results to higher frequencies enabled a check on the earlier assumption that only the lower frequencies are altered when the conformation is changed. This assumption underlies the evaluation of changes in internal energy with conformation from only the cold neutron data, as is done with the present data. An experiment was performed to evaluate the frequencies associated

with motion of water molecules adsorbed on the sodium salt of polyglutamic acid. The water was present only to the extent of about one molecule to each two or three residues. A number of distinct frequencies attributable only to the adsorbed water were observed which indicate a variety of bonding of the water molecule to the host polypetide. Author

N69-22729# Atomic Energy Of Canada, Ltd., Chalk River (Ontario).
LATTICE DYNAMICS OF HEXAMETHYLENETETRAMINE
B. M. Powell *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 185–195 refs (See N69-22710 11-24)
(SM-104/50) Avail: CFSTI

The frequencies of the normal modes of vibration for a deuterated organic molecular crystal were measured using inelastic neutron scattering techniques. The measurements were made along the high symmetry directions at 296°K, using a triple axis spectrometer. Deuterated hexamethylenetetramine (DHMT) is a simple molecular crystal which crystallizes in a body centered cubic structure. The molecules have cubic symmetry, and it is believed that the intramolecular forces are much stronger than the intermolecular ones. The molecules can thus be considered as rigid units with three translational and three librational degrees of freedom. For any general wave vector there will thus be six normal modes, each comprising both translational and librational components. The effect of the librational components can be seen in the very different neutron group intensities observed along similar directions in reciprocal space. A simple model was previously proposed for normal hexamethylenetetramine and dispersion curves were calculated in the symmetry directions. The present results indicated that the model is a reasonable approximation and, by fitting the observed frequencies, the parameters of the model for DHMT can be determined. Author

N69-22730# Instituto De Energia Atomica, Sao Paulo (Brazil).
SLOW-NEUTRON SCATTERING AND ROTATIONAL FREEDOM OF METHYL GROUPS IN SEVERAL ORGANIC COMPOUNDS
S. B. Herdade *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 197–204 refs (See N69-22710 11-24)
(SM-104/106) Avail: CFSTI

The total cross-sections of CH_3NO_2, $(CH_3)_2CO_2$, $(CH_3)_2SO$, $(CH_3CO)_2O$, CH_3CH, $(CH_3)_2SiCl_2$ and dimethyl polysiloxane (silicone oil) were measured for neutrons with wavelength λ_n in the range 5 – 10 Å. An empirical correlation was observed to exist between the slopes b_s and the barrier heights for internal rotation of CH_3 groups in the molecules, and a calibration curve was plotted using some of the experimentally determined slopes and published values of barrier heights determined by other methods. From the slopes for dimethyl polysiloxane it was concluded that the internal rotation of CH_3 groups in these compounds is practically free. An average barrier height of ~ 1 kcal/mole was estimated for $(CH_3CO)_2O$, from the experimentally determined slope 10.8 ± 0.3 b/Å-H. Author

N69-22731# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering
COHERENT INELASTIC NEUTRON SCATTERING BY MOLECULAR GASES. MEASUREMENTS ON C_2F_6 AND ROTATION-VIBRATIONS COUPLING CALCULATIONS FOR CD_4
J. M. Carpenter and N. A. Lurie *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 205–222 refs Supported in part by NSF and AEC (See N69-22710 11-24)
(SM-104/88)

Measurements of the scattering law for room temperature hexafluoroethane gas are reported, obtained for scattering angles between 4.8° and 90°, in which several inelastic scattering maxima of small amplitude were found. One at approximately 11 meV is interpreted as due to energy transfer with the internal torsional vibrational mode previously unobserved due to both Raman and infrared inactivity. Another, less well defined value, at 27 meV is thought to correspond to the doubly degenerate infrared active rocking mode. Another band centered at approximately 17 meV is possibly due to two quantum process involving several vibrational modes. A theoretical treatment of the scattering law for slow neutron scattering by molecular gases is presented for processes in which one vibrational quantum is exchanged. Formulas are derived using the technique of invariant imbedding, without the usual approximation of separating the intermediate scattering function for rotational and vibrational motions. These formulas permit rigorous quantum mechanical calculation of the scattering law for both spherical and diatomic molecules, for both coherent and incoherent scattering. Calculations for CD_4 gas are presented and compared to previous experimental values. The effect of the separation of rotational and vibrational scattering functions is discussed. Author

N69-22732# Oesterreichische Studiengesellschaft Fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
THE MOLECULAR DYNAMICS OF METHANE IN ARGON
O. J. Eder and P. A. Egelstaff (Atomic Energy Res. Estab., England) *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 223–235 refs (See N69-22710 11-24)
(SM-104/122) Avail: CFSTI

The inelastic and quasi elastic scattering of 5.3 Å neutrons were studied at 86°K. The experimental data were taken for two concentrations (1.6 and 3.2 molar %) and six scattering angles. A discussion of the changes in the scattering pattern as compared to scattering experiments on pure methane performed under comparable conditions is presented. A comparison with experimental data is made, using a new approach for the rotational motion of the methane molecules. It is assumed that the methane molecules rotate nearly freely at short times and undergo rotational diffusion at long times, while discussing the center-of-mass motion in terms of a modified itinerant oscillator model. The data are consistent with the view that the argon atoms form a 'cage' around the methane molecules in which the rotation is continuously but weakly hindered and where the long time translational motion can be described by simple diffusion, but for the short-time behavior some new approach is needed. Author

N69-22733# Joint Inst. For Nuclear Research, Dubna (USSR).
STUDY OF THE FREQUENCY DISTRIBUTION IN UNSTRETCHED AND STRETCHED RUBBER BY NEUTRON INELASTIC SCATTERING
E. Tunkelo (Helsinki Univ., Finland), A. Basorek, I. Natkaniec, K. Parlinski, and M. Sudnik-Hrynkiewicz *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 237–241 refs (See N69-22710 11-24)
(SM-104/26) Avail: CFSTI

Unvulcanized natural rubber was studied in the normal state and stretched to about five times its original length using time-of-flight techniques in a pulsed reactor. The energy analysis was performed with a beryllium filter and in some of the experiments with the additional Bragg reflection from a large single crystal of zinc to obtain a better resolution. Scattering together with the strain of the sample both parallel and perpendicular to the scattering vector was studied. The results were analyzed in terms of the frequency distribution function, assuming single phonon scattering to be dominant. The density of the low energy modes was found to be reduced by stretching. This may be attributed to the unlinear change of elastic constants in stretching, making the initial slope of

the dispersion curves more steep. The high energy modes were found to stay almost unchanged. An additional band of frequencies was found in the region of 10-12 meV in the case of the strain parallel to the scattering vector. This can be attributed to flattening of the dispersion curves in this energy region. It was concluded that the stretching of the sample shifts part of the low energy modes to higher energies, probably by making the dispersion curves steeper in the beginning and bending them more flat in the 10-meV region for phonons traveling in the direction of the strain. Author

N69-22739# Birmingham Univ. (England).
MEASUREMENT OF THE VIBRATIONAL SPECTRA OF MOLECULES BY MEANS OF THE DOWN SCATTERING OF NEUTRONS
M. M. Beg and D. K. Ross *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 299-312
(SM-104/117) Avail: CFSTI

A fast chopper has been used in conjunction with a beryllium filtered detector to measure the down-scattering cross section of a number of samples. An expression is derived for the overall resolution function which gives values of less than 15% in energy in the range 20 to 100 meV. The data is reduced to the form of the scattering law and is then compared with values obtained from an assumed form of the frequency distribution using the program LEAP. This program can be used to calculate the scattering law along the locus of the observed points in Q, w space. Data is presented for ammonium chloride, zirconium hydride, water and benzene. In the case of water, the agreement with the Haywood frequency distribution is good except that the hindered rotation peak appears at a slightly lower energy. Author

N69-22741# Idaho Nuclear Corp., Idaho Falls.
THE "SMALL k" METHOD OF NEUTRON MOLECULAR SPECTROSCOPY
R. M. Brugger, K. A. Strong, and D. M. Grant *In* IAEA Neutron Inelastic Scattering, Vol. 2 1968 p 323-329 refs Supported by the AEC (See N69-22710 11-24)
(SM-104/92) Avail: CFSTI

In slow neutron inelastic scattering experiments it was shown that discrete peaks can be observed in the neutron inelastic scattering spectra by observing the spectra at small momentum changes $\hbar\kappa$. Similar peaks are not observed in data at higher momentum changes because the widths of the elastic and inelastic peaks which are proportional to $\kappa\sqrt{kT/M}$ are large enough to overlap. Here T is the absolute temperature and M is the effective mass. Lowering T and increasing M narrows the peak to some extent, but often the former change induces a phase change in the sample under study. The most effective way to narrow the peaks so that they do not overlap and can be observed as discrete peaks is to make κ small. In the MTR experiments this is achieved by observing the scattering at smaller angles and with incident neutrons of a higher energy. Because the inelastic scattering intensity is small compared to the elastic scattering, much care must be given to suppressing the background, multiple scattering, and air scattering. Data showing the transitions between librational levels in liquid neopentane will be shown to demonstrate the effectiveness of the small κ method of neutron molecular spectroscopy. Author

N69-22751*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HELICAL DUCT GEOMETRY ROUTINE FOR THE FASTER COMPUTER PROGRAM
Thomas M. Jordan (ART Res. Corp.) and Millard L. Wohl Mar. 1969 20 p ref
(NASA-TM-X-52567) Avail: CFSTI CSCL 20H

A method for tracking neutrons through slabs penetrated by helical voided ducts is presented and verified by means of a high efficiency Monte Carlo computer code, designated FASTER. A point fission source is located at the center of the entrant mouth of the duct. Neutron number spectra, computed at point detectors in and near the emergent mouth of the duct, are compared with similar results computed by the FASTER code and the another code using cylindrical geometry to describe the duct. The helical duct is given a very large pitch to simulate a cylindrical duct within the slabs considered. The comparison of number spectra is almost exact, verifying the techniques developed herein. FORTRAN listings of computer subroutines which perform the numerical analysis are included. Author

N69-22753# Oak Ridge National Lab., Tenn.
SOURCES OF TRITIUM AND ITS BEHAVIOR UPON RELEASE TO THE ENVIRONMENT. AEC CRITICAL REVIEW SERIES
D. G. Jacobs 1968 90 p refs
(Contract W-7405-ENG-26)
(TID-24635) Avail: CFSTI

An attempt is made to summarize some of the important properties of tritium and to use these properties in predicting the impact of diverse releases of tritium on local and worldwide populations. Sources of tritium production and its release, procedures for tritium enrichment, monitoring practices and instruments for the detection and assay of tritium, tritium movement in the environment, and projected tritium production in a nuclear power economy are discussed topically. Areas in which more precise knowledge is needed to improve estimates of environmental contamination are indicated. NSA

N69-22765# California Univ., Livermore. Lawrence Radiation Lab.
A COMPUTER METHOD OF PEAK AREA DETERMINATIONS FROM Ge-Li GAMMA SPECTRA
H. Robert Ralston and George E. Wilcox 30 Aug. 1968 14 p refs Presented at Intern. Conf. on Mod. Trends in Activation Anaal., Gaithersburg, Md., 7-11 Oct. 1968
(Contract W-7405-eng-48)
(UCRL-71210; CONF-681003-8) Avail: CFSTI

A computer method for determining an appropriate base line (Compton level) from which to begin and end the integration of a peak area and, also, for determining the amplitude of the Compton continuum at the location of the peak is described. NSA

N69-22780# Bureau International des Poids et Mesures, Sevres (France).
INTERNATIONAL COMPARISON OF A SOLUTION OF Mn SUP 54 [COMPTE RENDU DE LA COMPARISON INTERNATIONALE D'UNE SOLUTION DE Mn 54]
H. M. Weiss, ed. 30 Oct. 1968 41 p refs In FRENCH; ENGLISH summary
(NP-17716) Avail: CFSTI

The CENS distributed ampoules of a solution of ^{54}Mn to national and international laboratories for an international comparison. An accidental contamination of the distributed solution by about 2% of ^{35}S gave rise to troubles and loss of accuracy in many of the measurements. The methods applied can be grouped into: x-ray measurements, coincidence measurements and the comparison of the γ-emission rate of the contaminated solution with that of a pure calibrated ^{54}Mn solution. The large spread

in the results of the x-ray measurements of about 13% is mainly due to difficulties in the determination of the self- and foil-absorption and in the extrapolation to 100% efficiency. Similarly, rather large deviations also occurred in the coincidence measurements. They are primarily caused by the ^{35}S contamination. In the present case, γ comparison with a pure solution can be considered as the most reliable procedure. The results of this group show a total spread of about 2%. Author (NSA)

N69-22781# United Kingdom Atomic Energy Authority, Harwell (England).
PROCESSING OF DATA FROM A γ SPECTROMETER APPLICATION TO THE STUDY OF DECAY SYSTEMS
J.-P. Boulanger and J. Legrand Nov. 1967 29 p refs Transl. into ENGLISH from the French rept. CEA-3285
(NP-tr-1713; CEA-R-3285) Avail: CFSTI

A numerical method for analysis of data from gamma spectrometers for radioanalysis and the establishment of decay schemes is described. Some results of the method applied to scintillation gamma spectroscopy of the ^{134}Cs system and semi-conductor gamma spectroscopy of the ^{95}Zr-^{95}Nb system are presented. NSA

N69-22782# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SYSTEM FOR THE ANALYSIS OF GAMMA-RAY SPECTRA BY THE METHOD OF SIMULTANEOUS EQUATIONS
F. Delano Knight Nov. 1968 21 p refs
(Contract AT(07-2)-1)
(DP-1171) Avail: CFSTI

A complete system for the quantitative separation of complex gamma-ray spectra into their component nuclides was developed and programmed in FORTRAN IV for the IBM 360/65. This system was developed to analyze routine data generated by two multi-channel analyzers (three crystal systems). The system also maintains a current library of standard spectra. The method of simultaneous linear equations is employed. Author (NSA)

N69-22806# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.
METHODS OF ANALYSIS OF GAMMA SPECTRA [METHODEN ZUR ANALYSE VON GAMMA-SPEKTREN]
V. Hasse Apr. 1968 46 p refs In GERMAN
(KFK-730) Avail: AEC Depository Libraries

Numerical methods for the analysis of complex γ spectra, as are obtained with multichannel analyzers and data processing computers, are described. The emphasis of the analysis is on the spectral correction for the effect of the measureing apparatus. The three phases of the correction of measurement data are single-value corrections, corrections to the spectrum or unscrambling, and corrections according to the intensity calculation. NSA

N69-22808# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
STUDY OF IONOGRAPHIC TRACKS IN INSULATORS. LITERATURE SURVEY [ETUDE DES TRACES IONOGRAPHIQUES DANS LES SOLIDES ISOLANTS]
Jean-Jacques Thomas (Toulouse Univ.), Jean-Louis Teyssier (Toulouse Univ.), Anne-Marie Chapuis, and Henri Francois Jul. 1968 98 p refs In FRENCH
(CEA-Bib-122) Avail: AEC Depository Libraries

A literature survey of results published before 1967 on the detection of ionizing particles in solids is presented. The different modes of observation and of chemical development of these tracks and the criteria proposed for classifying the detector materials as a function of their sensitivity are described. A brief review of the hypotheses which make it possible to explain partially the mechanism of formation of tracks is included. The description of these detectors is limited to those liable to find applications in nuclear physics (spallation and fission reactions, cross-section measurements, neutron dosimetry) and geophysics (study of fossil tracks in natural ores of terrestrial or extra-terrestrial origin). Author (NSA)

N69-22817# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INTERFERENTIAL EFFECTS WHILE REGISTERING PAIRS OF UNSTABLE PARTICLES
V. L. Lyuboshits and M. I. Podgoretskii 1968 17 p refs In RUSSIAN
(JINR-P2-4145) Avail: AEC Depository Libraries

General formulas are obtained for the probability of registration of the pairs of unstable particles and the resonances in the correlation experiments. It is shown that, while registering, by one detector, the decay products of two particles with equal conserved quantum numbers, the interferance takes place which depends on the inherent flight time of particles and is connected with the non-orthogonality of the inner wave functions. Author (NSA)

N69-22827# Bonn Univ. (West Germany).
ELASTIC SCATTERING OF 52 MeV DEUTERONS
F. Hinterberger 22 Feb. 1968 83 p refs In GERMAN
(BMwF-FBK-68-16) Avail: AEC Depository Libraries

The elastic scattering of 52 MeV deuterons was studied on 27 target nuclei from hydrogen to uranium. The measured angular distributions are analyzed in terms of the optical model. The deuteron optical model parameters of the nuclei with $A \geq 12$ are discussed with respect to the dependence upon the energy E, the charge Z, and mass A, to the information about nuclear structure, and to the results in distorted wave Born approximation analyses. In the case of ^1H (d,d) ^1H, ^3He (d,d) ^3He, and ^4He (d,d) ^4He, the differential cross sections at backward angles can be understood as a superposition of a shape-elastic and nucleon transfer process. Author (NSA)

N69-22854# Academia R. P. R., Bucharest. Inst. de Fizica Atomica.
ON THE QUADRUPOLE-OCTUPOLE ANHARMONICITY IN THE VIBRATIONAL MOTION OF EVEN-EVEN SPHERICAL NUCLEI
A. A. Raduta, A. Sandulescu, and C. Stratan 1968 28 p
(IFA-FT-69) Avail: CFSTI

A new method for treating the double quadrupole-octupole phonon states is given in which only the anharmonic terms which arise from the commutation of quadrupole and octupole operators are retained in the equations of motion. This gives nonlinear equations of motion, consequently modifying the quintet shift and the electromagnetic transaction. NSA

N69-22855# Academia R. P. R., Bucharest. Inst. de Fizica.
APPLICATIONS OF THE MATRIX CALCULUS TO THE NUCLEAR REACTOR PHYSICS AND TECHNIQUE

T. Rosescu 1968 25 p refs
(IFA-FR-66) Avail: CFSTI

A bibliography on the use of matrices and matrix notation in reactor physics calculations is given. The types of problems and areas where matrices are applicable are listed. NSA

N69-22868# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

A STUDY OF FILTERING PROBLEMS OF BACKGROUND NOISE IN NUCLEAR SPECTROMETRY, IMPROVEMENT OF SIGNAL TO NOISE RATIO, AND OF PULSE CHARACTERISTICS PRODUCED BY THE OPTIMUM PREDICTOR DEVICE [ETUDE DE PROBLEMES DE FILTRAGE DE BRUIT DE FOND EN SPECTROMETRIE NUCLEAIRE, AMELIORATION DU RAPPORT SIGNAL SUR BRUIT ET DES CARACTERISTIQUES DE L'IMPULSION MISE EN FORME PAR LE DISPOSITIF DU PREDICTEUR OPTIMUM]

Jerzy Benda (Ph.D. Thesis--Paris Univ., 26 May 1967) 1968 54 p refs In FRENCH; ENGLISH summary
(CEA-R-3420) Avail: CFSTI

The purpose of nuclear spectrometry is the precise measurement of particle energy. The resolving power of a spectrometer is an important design factor. Two main phenomena are involved in the limitation of this resolving power, i.e. the statistical fluctuations of the detector itself, and the background noise. For a given noise the theory of filters enables one to calculate networks specially designed for the improvement of the signal to noise ratio. The proposed system should lead to an imorovement of 10.5 per cent of this ratio and experiments have confirmed this theoretical estimation. The predictor device also makes it possible to obtain shortened pulses. Author (ESRO)

N69-22869# Atomic Power Development Associates, Inc., Detroit, Mich.

EVALUATED NEUTRON CROSS SECTIONS OF NA-23 FOR THE ENDF/B FILE

T. A. Pitterle Jun. 1968 43 p refs
(Contract AT(11-1)-865)
(APDA-217; ENDF-121) Avail: CFSTI

An evaluation of ^{23}Na neutron cross section data was carried out for the ENDF/B file. Data were evaluated from 10^{-5} eV to 15 MeV for the following neutron reactions: total, elastic scattering including Legendre polynomial expansions of the angular dependence, nonelastic, inelastic including resolved levels, (n,γ), (n,p), (n,α), and $(n,2n)$. Graphs of the evaluated data are compared with experimental data. Author (NSA)

N69-22875# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.

STUDY OF ELECTROMAGNETIC TRANSITION RATES BY LIFETIME MEASUREMENT OF EXCITED NUCLEAR LEVELS FOLLOWING NEUTRON CAPTURE [UNTERSUCHUNG VON UBERGANGSRATEN ELEKTROMAGNETISCHER UBERGAENGE DURCH MESSUNG DER LEBENSDAUER ANGEREGTER KERNNIVEAUS NACH NEUTRONENEINFANG]

Heinz Nuckelek (Ph.D. Thesis) Nov. 1968 40 p refs In GERMAN; ENGLISH summary
(SGAE-PH-78/1968) Avail: CFSTI

The gamma ray transition probability between nuclear states is expressed by transition matrix elements depending on the amplitudes and phases of the wave functions involved. Lifetime measurements in the nanosecond region of excited nuclear states were performed. The results are expressed in Weisskopf-units. The nuclei selected for investigation are the odd mass deformed nuclei ^{153}Sm, ^{163}Dy, ^{165}Dy, ^{167}Er, ^{169}Yb, and the odd-proton, odd-neutron nuclei ^{56}Mn, ^{198}Au. The neutron capture reaction is used for excitation. The lifetime measurements were performed by direct timing of a γ--γ cascade using scintillation detectors and fast photomultipliers. The electronic system consists of a fast--slow coincidence system with time-to-amplitude converter and multichannel analyzer incorporated. The typical time resolution is of the order of one nanosecond. Author

N69-22882# Brookhaven National Lab., Upton, N. Y.

ENHANCEMENTS IN THE 2 AND 3 PION MASS SPECTRA NEAR 1.7 GeV OBSERVED IN THE REACTION OF 8GeV/C π^- MESONS WITH DEUTERIUM

A. M. Cnops, P. V. C. Hough, and F. R. Huson 1968 8 p Submitted for Publication Sponsored by the AEC
(BNL-12676; Conf-680809-9) Avail: CFSTI

Neutral, even g-parity systems, and both charged and neutral odd g-parity systems were observed. In particular the charged and neutral 3π systems are compared. The deuterium bubble chamber was exposed to a beam of 8-GeV/c π^- and the channels were studied. Three enhancements were observed. These were an even mass 1707 $\pm$ 16 decaying into two pions, and odd g-parity neutral enhancement of mass 1687 $\pm$ 16 MeV decaying predominantly into $\rho\pi$ and with $\rho\pi$ branching ratios consistent with an I = 0 assignment, and an odd g-parity charged enhancement of mass 1710 $\pm$ 22 MeV for which no evidence is found for either strong $\rho\pi$ or f π decay modes. From the differences in decay modes it was concluded that the two odd g-parity enhancements are different states. NSA

N69-22883# Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. High Energy Lab.

CALCULATION OF PERTURRED ORBITS FOR RESONANT EXTRACTION FROM NIMROD

J. Ranft Apr. 1968 53 p
(RHEL/R-163) Avail: CFSTI

Various techniques of initiating 2/3 resonant extraction from Nimrod are studied. Different types of magnetic field perturbation, and different methods of driving the whole beam into resonance, are examined and compared. Criteria such as the minimization of beam divergence spread in the septum magnet and tolerances on the various parameters lead to a recommended scheme: a continuous field perturbation derived from poleface windings in all the Octants (first harmonic sin 2θ azimuthal variation, and quadratic radial variation) and a driving term obtained from a time-varying magnetic field bump provided by special windings outside the septum. Author (NSA)

N69-22899# Ceskoslovenska Akademie Ved, Rez.

THE DECAY OF La-131

A. Spalek, I. Rezanka, J. Frana, J. Jursik, and M. Vobecky May 1968 26 p refs
(UJV-2036) Avail: CFSTI

The decay of ^{131}La ($T_{1/2}$ = 61 min) was investigated by means of Ge(Li) and Si(Li) spectrometers and Ge(Li)--NaI(Tl) coincidences. The decay scheme for ^{131}La is presented including four new levels. Of the two possibilities for ^{131}La ground state spin, 1/2 or 3/2, the former value is preferred. The results are discussed in terms of analogies with neighboring nuclei. Author (NSA)

N69-22901# California Univ., Santa Barbara. Dept. of Physics.

COMPARISON OF π^+ AND π^- LIFETIMES TO CHECK CPT INVARIANCE

David O. Caldwell, Virgil B. Elings, William P. Hesse, Rollin J. Morrison, David S. Ayres (UCRL, Berkeley) et al Jul. 1968 13 p
(Contract AT(11-1)-34)
(UCSB-34-P-135-6) Avail: CFSTI

A precise experiment was performed to look for any difference between the total lifetimes of the π^+ and its anti-particle, the π^-. Observation of such a difference would be direct evidence for a violation of charge parity time (CPT) invariance in the weak decay of the charged pion. This is the second π^+/π^- lifetime ratio experiment at the 184-inch cyclotron and again involves counting the number of surviving pions as a function of distance, using a liquid hydrogen (or deuterium) Cherenkov counter. However, the beam flux was increased two orders of magnitude and the apparatus was entirely rebuilt so as to reduce considerably systematic errors. It is now found that $\tau_+/\tau_- = 1.00064 \pm 0.00069$, and thus (to a much better precision than has heretofore been available) no evidence for CPT violation in this decay. Also an improved value for the π^- lifetime was obtained, and although this analysis is not completed, a preliminary value is $\tau_- = 25.97 \pm 0.04$ nsec.
Author (NSA)

N69-22909# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
ANNOTATED BIBLIOGRAPHY OF CURIUM
H.W. Miller 1 May 1968 87 p
(Contract AT(29-1)-1106)
(RFP-1081) Avail: CFSTI

Five hundred and ten references on curium, complete to the year 1967, are presented. The bibliography is divided into two main sections: chemistry and physics. These two sections are further subdivided into categories. Author, subject, and organization symbol indexes are included.
NSA

N69-22934*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTICAL MODEL ANALYSIS OF PROTON SCATTERING IN THE RANGE 16 TO 22 MeV
Edmund T. Boschitz Washington Apr. 1969 37 p refs
(NASA-TN-D-5067) Avail: CFSTI CSCL 20H

Polarization, differential cross section, and total reaction cross section data for the scattering of 16- to 22-MeV protons from complex nuclei were analyzed with the optical model. An average potential was obtained which describes most of the data. Deviations from the average spin orbit potential were observed for nuclei with doubly closed shells. The analysis of the energy dependence of proton scattering from O^{16} showed that a smooth variation of the optical model parameters results in satisfactory fits to the data between 30 and 50 MeV. The parameters cannot be extrapolated into the 20-MeV range.
Author

N69-22948# Paris Univ., Orsay (France). Lab. de Physique Theorique et Hautes Energies.
THE SUPERWEAK MODEL OF PC VIOLATION
M. Gourdin Mar. 1968 20 p refs In FRENCH Presented at the Conf. on Electromagnetic Interactions, LAC-de-Tignes, France, 9-19 Mar. 1968
(LPTHE-TH-68/12; CONF-680318-1) Avail: CFSTI

The superweak theory of PC violation, proposed by Wolfenstein, is presented in a more systematic fashion and freer from contingencies due to discrete symmetries. The results obtained are compared with experimental data.
NSA

N69-22952# United Kingdom Atomic Energy Authority, Harwell (England).
POSSIBLE WAY OF MEASURING THE ENERGY OF RELATIVISTIC PARTICLES BY MEANS OF TRANSITION RADIATION
K. A. Ispiryan and A. G. Oganesyan Jul. 1968 8 p refs Transl. into English from the Russian rept. EFI-ME-4(68)
(NP-tr-1717; EFI-ME-4(68)) Avail: CFSTI

A discussion is given of the angular distribution of the intensity of the transition radiation emitted in the optical frequency range by high energy particles. It is shown that the sharp dependence of the intensity of radiation emitted into a certain angular interval can be used to measure the energy of high energy particles.
Author (NSA)

N69-22956# California Univ., Berkeley. Lawrence Radiation Lab.
EXCHANGE AMPLITUDE CONTRIBUTIONS TO THE REACTION NEGATIVE KAON + PROTON YIELDS LAMBDA HYPERON + NEUTRAL PION NEAR 1 BeV/c
James Louie (Ph.D. Thesis) Aug. 1968 78 p refs
(Contract W-7405-eng-48)
(UCRL-18411) Avail: CFSTI

The reaction $K^- + p \rightarrow \Lambda + \pi^0$ was analyzed in terms of direct channel resonances and background exchange amplitudes, making fits to experimental angular distributions, Λ polarizations, and $\Lambda\pi^0$ cross sections over the center-of-mass energy range 1700 to 1850 MeV. The primary aim was to investigate the nature of the background terms, using K^* and nucleon crossed-channel exchanges, in the scattering amplitude required to fit out data. Previous J^P assignments were confirmed for $Y_1^*(1660)$, $Y_1^*(1770)$, and $Y_1^*(2030)$, and branching ratio products $x_{KN}x_{\Lambda\pi}$ for these three resonances were presented. A mass and width for $Y_1^*(1770)$ were also determined. The data do not show much sensitivity to the presence of $Y_1^*(1910)$. The assumption of simple background exchange terms alone did not seem to be sufficient to fit the data. Modifications to these terms were made, producing reasonable fits. Effects due to the assumptions of the absorption model were also considered.
Author (NSA)

N69-22961# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
EFFECTS OF THE GENERALIZATIONS DUE TO APPROXIMATIONS USED IN THE MULTIPLE COLLISION METHOD [UEBER DIE EINFLUESSE DER BEIM STOSSFOLGENVERFAHREN UEBLICHEN VERNACHLAESSIGUNGEN]
H. Hoertner and F. Putz [1968] 138 p refs In GERMAN Submitted for publication
(SGAE-RT-17/1968) Avail: CFSTI

The errors are investigated which occur due to the usual assumptions of the multiple collision method when calculating the thermal utilization factor in plane geometry. A first order approximation of the anisotropic solid angle distribution of the neutron currents is considered; furthermore exact formulas for the second collision probabilities are derived. For the higher collision probabilities the asymptotic expressions for an infinite number of collisions are used. The effects are discussed in detail by means of numerous numerical results.
Author

N69-22980# California Univ., Berkeley. Lawrence Radiation Lab.
ARE THERE ANY FAR-OUT MESONS FOR BARYONS?
Arthur H. Rosenfeld May 1968 29 p refs Submitted for publication
(Contract W-7405-ENG-48)
(UCRL-18266; Conf-680428-9) Avail: CFSTI

Evidence for far-out (in weight space) mesons and baryons is considered. It is shown that the number of claims corresponds reasonably well to the number of statistical fluctuations that one would expect. If far-out mesons are being produced, their cross sections are below the 10 μb level. Properties of far-out mesons (Q or $|I \geq 3/2$ cannot be formed from quark–antiquark pairs), absence of evidence for the exchange of virtual far-out mesons, the periodic appearance of 4σ fluctuations in some channels the absence of direct evidence, a summary of far-out spectra, the status of far-out baryons, and the uncertainty in $K^+ + n \rightarrow Z_0$ (1865) and $K^+ + p \rightarrow Z_1$ (1900) are covered. A prescription for the identification of a resonance is also given. NSA

N69-23000# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON THE EFFECTS OF THE CLASHING μ-MESON BEAMS
F. F. Tikhonin 1968 14 p refs In RUSSIAN
(JINR-P2-4120) Avail: AEC Depository Libraries

Possible effect of the weak interaction on the $\mu^+ + \mu^- \rightarrow \mu^+ + \mu^-$ scattering and the $\mu^+ + \mu^- \rightarrow e^+ + e^-$ reaction, both through the neutral lepton currents and the charged ones (in the second order on weak constant), is being considered. The calculations show that P-odd effects in the mentioned processes would prove the existence of the neutral currents which, in their turn, give the principal basis for explanation of the mass difference of a muon and an electron. Author (NSA)

N69-23029# Pennsylvania Univ., Philadelphia. Dept. of Radiology.
PARAMAGNETIC RESONANCE IN LiF
Peter Bloch *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 317–321 refs (See N69-23005 11-06)
(Grants PHS-3T1-RH50-0253(67); PHS-5R01-RH-00443-15)
Avail: CFSTI

From electron spin resonance measurements, it was found that titanium is an impurity in TLD-100 grade LiF. The concentration of Ti was estimated to be approximately 10 ppm. After exposure of the LiF to 6000 R of ^{60}Co radiation, two satellite lines of the titanium resonance appear in the ESR spectrum. This indicates that the Ti ion is strongly coupled with a trapped electron. The strong ion-electron interaction shown by the ESR measurements, in conjunction with previous experiments, suggests a strong interaction between electron trap centers and luminescent centers in LiF. Author

N69-23030# National Bureau of Standards, Washington, D. C.
INFLUENCE OF IRRADIATION RATE ON THE PRODUCTION OF F CENTERS IN LiF (TLD GRADE)
Margarete Ehrlich *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 322–326 refs (See N69-23005 11-06)
Avail: CFSTI

Optically polished samples of extruded plaques of LiF(thermoluminescence dosimetry (TLD) grade) were given ^{60}Co gamma ray exposures ranging from about 35,000 to 460,000 R, at exposure rates between about 1.5×10^3 and 5×10^6 R/h. Over this range of exposures and exposure rates, the resulting absorption in the F band was found to be independent of exposure rate, and to increase with exposure, even when the thermoluminescence exhibited saturation effects. After thermoluminescence readout at about 235°C, practically all the absorption in the F band created by the ^{60}Co gamma ray exposures had disappeared. These results are compatible with the dominant role given F centers in some of the current models for the thermoluminescence process in LiF(TLD grade). Author

N69-23035# Naval Research Lab., Washington, D. C. Dosimetry Branch.
VARIATION OF ELECTRON-INDUCED RADIOLUMINESCENCE IN LITHIUM FLUORIDE AS A FUNCTION OF TOTAL DOSE
F. H. Attix, E. J. West, and J. A. Pfaff *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 389–395 refs Sponsored jointly by AEC and Office of Naval Res. (See N69-23005 11-06)
Avail: CFSTI

A measurement was made of the radioluminescence brightness of LiF under constant electron beam excitation, as a function of the total dose accumulated by the phosphor. It is found that between 10^3 and 10^5 rad this radioluminescence increases in brightness gradually by about 50 percent. The corresponding gain in thermoluminescence sensitivity is about tenfold larger. A qualitative explanation in terms of the model of Klick and Claffy is proposed. Author

N69-23037# Texas Univ., Houston.
THE ENERGY RESPONSE OF LiF, CaF_2, AND $Li_2B_4O_7$:Mn FROM 26 KeV TO 22 MeV
P. R. Almond, K. McCray, D. Espejo (Hosp. San Jose, Monterrey, Mex.), and S. Watanabe (Inst. de Energia Atomica, San Paulo, Brazil) *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 410–423 refs (See N69-23005 11-06)
(Grant PHS CA-06294)
Avail: CFSTI

To investigate further the energy dependence of ^7LiF, and to see if other phosphors exhibit a similar effect, the energy dependence measurements were repeated for ^7LiF and were also performed for CaF_2 and $Li_2B_4O_7$. The measurements were made from an effective X-ray energy of 26 KeV to 22 Mv X-rays and for 6 to 8 MeV electrons. The 6 to 10% decrease in response for LiF was again found and a 3% decrease was found for both CaF_2 and $Li_2B_4O_7$. The difference between ^7LiF and CaF_2 and $Li_2B_4O_7$ can be considered as real since the exposures were undertaken using at each energy, the same calibration. In order to explain the results, the general cavity theory derived by Burlin has been used. Applying this theory, very good agreement with the experimental data is obtained over the entire energy range. This indicates that when interpreting TLD data, the appropriate theory must be considered. Author

N69-23040# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif. Lab. Producto Div.
RESPONSE OF CALCIUM FLUORIDE AND LITHIUM FLUORIDE TO ALPHA PARTICLES
A. C. Lucas and C. Rainbolt *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 456-463 (See N69-23005 11-06) ref
Avail: CFSTI

The response of hot pressed samples of lithium fluoride and calcium fluoride to americium-241 alpha particles was measured by allowing the particles to be totally stopped in the sample material. A collimated beam of alpha particles was standardized by measuring the total ionization produced in air. Lower energy alpha particles were produced by placing mylar absorbers between the source and the sample. Spectra were measured using a silicon spectrometer. The response of the TLD materials was found to be less than that measured for gamma rays when the data were reduced to light emitted per unit energy deposited in the phosphor. The relative efficiency of calcium fluoride varied from 0.32 to 0.20 while that of lithium fluoride varied between 0.14 and 0.07. The glow curve shape was variable for lithium fluoride, and the sensitivities inferred depend on the readout method. In general, lithium fluoride has a greater sensitivity to heavy charged particles when the glow curve is integrated than when the dominant peak in the glow curve is used as a measure of absorbed energy. Author

N69-23041# Oxford Univ. (England). Research Lab. for Archaeology.

DEVELOPMENT AND APPLICATION OF CALCIUM FLUORIDE FOR EVALUATION OF DOSAGE WITHIN A RADIOACTIVE POWDER MATRIX

S. J. Fleming *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 464-482 refs (See N69-23005 11-06)

Avail: CFSTI

Calcium fluoride grains intimately mixed in a radioactive powder matrix containing a mixture of alpha and beta radiation will measure the radiation dosage within the matrix, subject to assumptions firstly concerning the relative efficiency of the two forms of radiation in producing thermoluminescence in the phosphor, and secondly concerning the attenuation characteristics of the phosphor for the short range alpha particles. A calcium fluoride was prepared with a radiation insensitive outer layer, of thickness corresponding to the maximum effective ranges of the alpha particles studied, by the controlled diffusion of oxygen into the 100 micron grains used. Thus the two components of dosage arising from the alpha and beta radiation may be separated and evaluated by comparison of the thermoluminescence from the completely sensitive grains and similar material which has been oxygenated. The mechanism of the diffusion process, and its effect on thermoluminescence sensitivity, is discussed. Author

N69-23042# Battelle-Northwest, Richland, Wash.

THE RESPONSE OF SELECTED THERMOLUMINESCENT MATERIALS TO FAST-NEUTRON EXPOSURES

G. W. R. Endres and L. F. Kocher *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 486-500 (See N69-23005 11-06) refs

(Contract AT(45-1)-1830)

Avail: CFSTI

The studies described were undertaken to determine the optimum thermoluminescent dosimetry (TLD) material for personnel dosimetry, in those facilities where significant fast neutron fields may be present; it is directed toward measuring the fast neutron response of most of the common TLD materials when placed on a phantom, thus simulating actual personnel dosimetry conditions. The TLD materials used were LiF, $Li_2B_4O_7$, CaF_2, and BeO in either pressed block or teflon matrix form. Exposures to fast neutrons were conducted using a Van de Graaff positive ion accelerator to produce monoenergetic neutrons in the energy range 0.2 to 1.0 MeV from the T(p,n)^{3}He reactions. Exposures were made in air with low-scatter conditions, with a polyethylene phantom placed behind the TLD material, and with cadmium and boron-10 shields surrounding the material in an attempt to evaluate the contribution of backscattered neutrons. The standard used for dose measurement was the Hanford precision long-counter. The results of the studies are given in the form energy response curves. Author

N69-23045# Massachusetts General Hospital, Boston. Physics Research Lab.

SOME STUDIES ON THERMOLUMINESCENCE FROM LITHIUM FLUORIDE AND OTHER MATERIALS EXPOSED TO NEUTRONS AND OTHER RADIATIONS

K. Ayyangar, A. R. Reddy, and G. L. Brownell *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 525-542 refs (See N69-23005 11-06)

Avail: CFSTI

Studies were made on the response of lithium fluoride and other commercially available thermoluminescent powders when exposed to neutrons and gamma rays in the medical facility of the MIT reactor. The thermal neutron flux at this facility is about 2 x 10^{10} n/cm^2-sec, and the gamma ray dose rate is about 25 rad/min. Lithium fluoride TLD-700 depleted of ^{6}Li is found to be sensitive to thermal neutrons and gives a ^{60}Co equivalent dose of 0.9 rad per 10^{10} nvt fluence. Activation analysis was used in a negative attempt to determine whether any element other than ^{6}Li contributes to the neutron response. Proton irradiations of TLD-700 were made for doses between 100 to 10,000 rads at 1, 2, 3 and 4 Kev/μ LET positions on the Bragg curve of 120 Mev beam. The doses measured with the TLD method seem to agree very well with those measured with standard methods. However, for intermediate dose regions of 500 to 1000 rads, the response of TLD-700 is 10 to 20% higher for protons supporting the observation that high LET radiation has less supralinearity. Author

N69-23046# Bettis Atomic Power Lab., Pittsburgh, Pa.

THE MEASUREMENT OF GAMMA LEVELS WITH Li^7F THERMOLUMINESCENT MATERIAL IN A MIXED GAMMA-NEUTRON FIELD

R. F. Beyer *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 543-551 refs (See N69-23005 11-06)

Avail: CFSTI

Exposure of commercially available Li^7F thermoluminescent material in a mixed gamma-neutron field results in a response due to both neutron and gamma rays. A simple method was developed to perform gamma measurements with Li^7F material in a mixed field. The technique uses two types of thermoluminescent phosphor. One is enriched in Li^7F and the other is enriched in Li^6F. The method is based on the fact that over a wide range of conditions, the relative neutron sensitivities between Li^7F and Li^6F detectors can be treated as a constant. The technique was developed primarily for gamma measurements where thermal neutron interactions dominate. The technique was verified experimentally by performing measurements in a critical facility (i.e., a zero power reactor) with two batches of Li^7F that had different neutron sensitivities. Author

N69-23047# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.

NEUTRON DOSIMETRY WITH ACTIVATION FILTERS AND TLD

L. F. Kocher and G. W. R. Endres *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 552-563 refs (See N69-23005 11-06)

(Contract AT(45-1)-1830)

Avail: CFSTI

A TLD dosimeter technique was developed to quantitatively determine fast and thermal neutron dosages from mixed radiation exposures. For fast neutron dosimetry, this method takes advantage of the scattering of thermalized neutrons from a hydrogenous moderator. The dosimeter housing consists of a standard Hanford beta-gamma film badge dosimeter. Three filters, consisting of combinations of lead, stainless steel, tin, cadmium, and rhodium are matched so as to produce equal TLD response from photon radiations. The fast and thermal neutron exposure is determined from the TLD response produced by the capture of moderated neutrons in the filter material. Where heterogenous radiation fields are encountered, a portion of the thermal neutrons is absorbed in one of the rhodium filter sandwiches. This differential forms the basis of a system to distinguish between fast and thermal neutrons. Rhodium was picked as the prime element of the filter system because it has an unusually large resonance absorption for neutrons of 1.26 eV. The capture cross section at 1.26 eV is 4500 barns. For a particular incident neutron energy, the activation of the rhodium should be directly proportional to the exposure or total flux. Author

N69-23048# Naval Research Lab., Washington, D. C. Dosimetry Branch.

THERMAL QUENCHING OF LUMINESCENCE IN SIX THERMOLUMINESCENT DOSIMETRY PHOSPHORS

S. G. Gorbics, A. E. Nash, and F. H. Attix *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 568-606 refs (See N69-23005 11-06) Sponsored Jointly by Office of Naval Res. and AEC
Avail: CFSTI

If thermal quenching is operative in the temperature region of the glow-peak, changes in heating rate which cause the temperature position of the peak to change would result in non-constant light sums. The direct measure of the TL light sum or the glow-peak height as a function of heating rate is technically difficult. The main problem is that the phosphor temperature tends to lag behind the heating planchet temperature by an amount which is a function of the heating rate and the degree of thermal coupling. Thus a thermocouple attached to the planchet provides an erroneous measure of the phosphor temperature. Initially this problem was side-stepped by studying the thermal quenching of the x-ray excited radioluminescence under static thermal conditions. Because of the observed similarity of these emission spectra to the corresponding thermoluminescence spectra, the emitting centers involved in both processes are probably the same for each phosphor studied. The resulting curves of brightness versus temperature were found generally to exhibit large discontinuities in the vicinity of the TL glow-peak temperatures, and were therefore difficult to interpret in terms of quenching of thermoluminescence. Author

N69-23049# Clarkson Coll. of Technology, Potsdam, N. Y. Dept. of Physics.
THE THERMOLUMINESCENCE SPECTRUM AND THE ENERGY CONVERSION EFFICIENCY OF LITHIUM-FLUORIDE
Alfred M. Strash and Richard Madey *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 607-612 refs (See N69-23005 11-06)
(Contract AT(30-1)-3646)
Avail: CFSTI

Thermoluminescence spectra are given for a sample irradiated with 98.1 MeV protons from cyclotron and also for another sample irradiated with cobalt-60 gamma rays. Both spectra appear to exhibit structure in the wavelength region around 5500A. For the proton irradiation, the time-integrated proton flux density was 4.97 $\times$ 10^9 protons/cm^2, which corresponds to an absorbed dose of 512 rads. For the gamma irradiation, the absorbed dose was 500 rads. Prior to irradiation in each case, the samples were given an annealing treatment of one hour at 400°C followed by 24 hours at 80°C. The samples had no prior irradiation history. Following irradiation the samples were heated to 100°C for 15 minutes. The thermoluminescence emission is proportional to the differential (in wavelength) efficiency. The differential efficiency is the thermoluminescence energy emitted per unit wavelength interval per unit mass of material per unit absorbed dose. The spectral data points represent thermoluminescence emission integrated over a small (60A) wavelength interval. Author

N69-23067# Oxford Univ. (England). Research Lab. for Archaeology
DATING OF ANCIENT POTTERY BY THERMOLUMINESCENCE
D. W. Zimmerman *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 858-867 refs (See N69-23005 11-06)
Avail: CFSTI

A convenient and accurate method of determining the absolute age of artifacts is described, which takes into account the following factors: (1) the effectiveness of alpha particles in inducing thermoluminescence, which varies for different pottery from 5 to 20% of the beta or gamma effectiveness; and (2) the inhomogeneity in thermoluminescent sensitivity and radioactivity of the constituents of the pottery. The thermoluminescence comes predominantly from mineral inclusions, whereas most of the uranium and thorium is in the clay matrix. Because of the short range of the alpha particles, the alpha dose received by the mineral inclusions in antiquities varies with size. Measurements were made using only fine grains of about 1 to 5μ in size, which were separated from the pottery and had suffered little attenuation of the alpha dose. The alpha and beta dose received in antiquity is from uranium, thorium, and potassium in the pottery, and this dose rate was determined by alpha counting and flame photometry. The gamma dose was determined by similar measurements on a sample of the soil that surrounded the pot in antiquity. A test program of fifty pottery fragments of known age, from 600 to 3500 B.P., gave the correct age for most archaeologic contexts to within $\pm$10 percent. Author

N69-23068# Atomic Energy Commission Research Establishment, Riso (Denmark).
DOSIMETRY PROBLEMS RELATED TO THE THERMOLUMINESCENCE DATING OF ANCIENT CERAMICS
Vagn Mejdahl *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 868-882 refs (See N69-23005 11-06)
Avail: CFSTI

A series of Danish sherds of known archaeological age, covering the period 4000 B.C. to 500 A.D., were used to evaluate a method based on the separation of large mineral inclusions to determine the natural thermoluminescence. Dosimetry problems related to the determination of accumulated exposure, intensity of radiation from sources inherent in the sherds, and intensity of natural background radiation at the excavation sites are discussed. The dates obtained by the thermoluminescent method are compared with the stated archaeological dates. Author

N69-23070# Commissariat a l' Energie Atomique, Fontenay-aux-Roses (France). Centre d Etudes Nucleaires.
RADIOTHERMOLUMINESCENT ALUMINUM OXIDE USED AS BUILDING MATERIAL FOR ACCIDENTAL γ RADIATION DOSIMETRY
Guy Portal, Henri Francois, Serge Carpentier, and Radovan Dajevic *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 894-909 refs (See N69-23005 11-06)
Avail: CFSTI

Crystallographic and chemical analyses were made on industrial aluminum oxide in relation to its energy response for X and gamma rays, as well as the sensitivity of the crystals to light and neutrons. A thermoluminescent glow curve was observed for four energy levels, two of which must be removed before readout to avoid the fading effect. The half life value of each energy level at room temperature is given, as well as the method used to measure the remaining two glow curves both separately and simultaneously. It was found that the sensitivity of this phosphor is fairly good, and an ordinary reader is capable of measuring from 500 mrad to 80,000 Rad. For low doses, it was necessary to remove triboluminescence with nitrogen during reading; different values of triboluminescence were reported depending upon treatment of the phosphor. In conclusion, the physical characteristics and ease of decontamination of various models of roof tiles, wall tiles, and bricks to be used in nuclear and public buildings are described, and a practical method for easy collection and reading of samples is proposed. Author

N69-23071# Kyoto Univ. (Japan). Research Reactor Inst.
APPLICATION OF THERMOLUMINESCENCE OF NATURAL QUARTZ TO ACCIDENT DOSIMETRY
Y. Ichikawa and T. Higashimura (Nara Univ. of Educ., Japan) *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 910-916 refs (See N69-23005 11-06)
Avail: CFSTI

The thermoluminescent properties of Brazilian quartz, grains of quartz contained within tuff, and quartz sands were determined after Co^{60} irradiation. The samples were ground with an agate mortar and pestle, and the resultant grains were sieved so that size distributions of 100 to 200 mesh were obtained. It was concluded that accident thermoluminescence dosimetry will be restricted by the background signal caused by irradiation over a long period of time by natural radiation. The relative advantages and disadvantages of using low and high temperature signals are discussed in relation to this limitation, with the most favorable results being obtained using a glow signal in the region of 110° to 250°C. Radiation doses as low as 100 r were measured using this temperature range.
Author

N69-23081# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
QUASI-RELATIVISTIC SCHROEDINGER EQUATION FOR BARYONS AND SU(6) SUB W SYMMETRY
A. P. Kobushkin and V. P. Shelest. 1968 13 p refs In RUSSIAN; ENGLISH summary
(ITF-68-19) Avail: AEC Depository Libraries

The problem of quasi-relativistic generalization of the Schrodinger equation for Dirac particles and bosons is considered in the framework of composite model in external magnetic field. It is shown that the ordinary quark spin must be replaced by W-spin in order that the equation obtained be consistent with the initial one. It means from the point of view of internal symmetry group that the nonrelativistic group SU(6) is replaced by quasirelativistic $SU(6)_W$.
Author (NSA)

N69-23082# Cologne Univ. (West Germany). Inst. fuer Kernphysik.
STUDY OF THE THREE-PARTICLE DECOMPOSITIONS N-14(alpha, alpha p)C-13 AND N-14(alpha, alpha d)C-12 AT A PRIMARY ENERGY E SUB alpha EQUALS 22.89 MeV
W. R. Kuhlmann. Mar. 1968 74 p In GERMAN
(BMwF-FBK-68-06) Avail: CFSTI

The three-particle reactions $^{14}N(\alpha,\alpha p)^{13}C$ and $^{14}N(\alpha,\alpha d)^{12}C$ were studied at an incident energy of E_α = 22.89 MeV by measuring α–p and α–d coincidence spectra. One detector (p,d) was fixed at θ = 25°, while the angle of the α detector was moved in the scattering plane. The following three-particle reactions were observed: $^{14}N(\alpha,\alpha p)^{13}C(0)$, $^{14}N(\alpha,\alpha p)^{13}C^*(3.09$ MeV and 3.68 or/and 3.85 MeV), $^{14}N(\alpha,\alpha d)^{12}C(0)$. They are sequential decays via the nuclei $^{14}N^*$ and $^{17}O^*(^{14}N(\alpha,\alpha p)^{13}C(0))$ and $^8Be^*$. $^{14}N^*$, and $^{16}O^*(^{14}N(\alpha,\alpha d)\ ^{12}C(0))$; in these nuclei there are only a few levels excited. In some cases angular correlations could be measured.
Author (NSA)

N69-23087# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
EXCLUSION OF ONE TYPE OF NONEXPONENTIALITY FOR K^0 MESON DECAY
L. I. Lapidus. 1968 12 p refs In RUSSIAN
(JINR-P2-4082) AEC Depository Libraries

It is shown that the discovery of nonzero charge asymmetry in K^0_{l3} decays at long distances after the target, where K^0 is produced, proves directly that high pole nonexponentiality of Goldberger–Watson (G–W) type is excluded for K^0 decays. It is shown that CPT- and T-symmetry conditions remain the same for any deviations from the exponential decay law. For the case of any nonexponentiality the expressions for the time dependence of amplitudes T^+ and T^- with the emission of l^+ and l^-, respectively, ($\theta = a_\mu$) are given. At long distances after the target usual expression for asymmetry a remains valid, when CPT-invariance and the rule $\Delta Q = \Delta S$ are valid. Previously it was proved from the Bell–Steinberger (B–S) type unitarity relation that for the high pole G–W case the states $|K^0_L>$ and $|K^0_S>$ are orthogonal without any relation to CP-invariance. It is clear that this formal possibility is excluded for K^0_{l3} decays.
Author (NSA)

N69-23090# Pakistan Inst. of Nuclear Science and Technology, Islamabad. Health Physics Div.
ESTIMATION OF GAMMA FLUX AT THE THERMAL COLUMN OF PAKISTAN RESEARCH REACTOR
Anwar Ali, Syed Mansoor Ahmed, and M. A. Mubarak. 1968 10 p refs
(PINSTECH/HP-5) Avail: AEC Depository Libraries

The thermal column of the Pakistan Research Reactor is described; the methods used in measurement of the γ dose rates are described. Results of dose measurements at power levels of 100 watts, 1, 10, and 100 KW, and 1 and 4 MW are tabulated. γ ray intensity resulting from thermal neutron radiative capture in Al, Pb, B, and C is tabulated as a function of energy. The γ dose rate at the face of the thermal column and the γ spectrum are shown graphically.
NSA

N69-23091# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
ALGEBRA OF CURRENTS. 2.
L. Maiani and G. Preparata. 1 Oct. 1968 61 p refs
(ISS-68/33) Avail: CFSTI

The most important results obtained from the algebra of currents introduced by Gell-Mann is reviewed. Included is a detailed discussion on the derivation of sum rules with $p \to \infty$ and with the covariant method. Theorems for the emission of zero energy pions are discussed, and applied to leptonic and non leptonic decays of K mesons, and to the 3π decay of the η meson. More recent developments of current algebra like the gauge fields current algebra, the Weinberg sum rules, and the applications of the Bjorken's method to weak and electromagnetic interactions are also discussed.
Author

N69-23132# Sandia Corp., Albuquerque, N. Mex.
COMPARISON OF SELECTED EXPERIMENTAL AND THEORETICAL PHOTON TRANSPORT RESULTS
James H. Renken. Oct. 1968 47 p refs Supported by AEC
(SC-RR-68-659) Avail: CFSTI

Photon transport calculations have been performed in order to compare results with data obtained in three recent shielding-type experiments. The Monte Carlo and discrete ordinates methods were used; comparisons of results from the two methods are discussed. Some x-ray-scattering data permit a clear assessment of the need to use the coherent-incoherent description of the scattering process, as opposed to the less-refined Klein-Nishina formula, in theoretical calculations. In general, the agreement between theory and experiment is good. Where discrepancies do exist, they can almost always be attributed to known shortcomings in calculations or difficulties with the experiments.
Author (NSA)

N69-23134# Princeton-Pennsylvania Accelerator, Princeton, N. J.
NUCLEAR CHEMISTRY RESEARCH AT PRINCETON UNIVERSITY Annual Progress Report, 1967-1968
T. D. Thomas, E. H. Spejewski, and R. A. Naumann. 8 Aug. 1968 69 p refs
(Contract AT(30-1)-2137)
(PPAD-647-D) Avail: CFSTI

The decays of ^{206}Au, ^{198}Cd, I isotopes, Po isotopes, and ^{193}Pt were investigated; information on the energy levels of Bi isotopes, ^{198}Ag, and Te isotopes was obtained. The production of ^{18}N and ^{21}O in the fragmentation of Au by 3 GeV protons

was observed. Fission fragment-γ coincidences in the spontaneous fission of ^{252}Cf were studied. The effects of deformation on the Coulomb barrier were investigated using the liquid-drop model. The use of the Moessbeuer effect to study particle motion in suspensions was studied. A search for particles with velocities greater than the velocity of light was initiated; an attempt was made to observe the emission of Cherenkov radiation. The nucleosynthesis of He in low-density hydrogen gas was studied theoretically. A holder for radioactive targets was developed. Ion sources for isotope separators were developed; the utilization of ^{252}Cl as a cold ion source was attempted. A chemical and structural investigation of the fluorides and oxyfluorides of Tc was undertaken. NSA

N69-23152# Kaman Nuclear, Colorado Springs, Colo.
EXPERIMENTAL INCOHERENT SCATTERING FUNCTION COMPENDIUM
William J. Veigele 17 Apr. 1968 28 p refs
(Contract N00014-67-C-0154)
(AD-681547; KN-68-259(R)) Avail: CFSTI CSCL 20/8

A compendium of experimental incoherent scattering function data for 11 elements was prepared, and it and its accompanying bibliography of original sources are presented here. The data are presented as functions of the scattering angle. Author (TAB)

N69-23153# Ceskoslovenska Akademie Ved, Rez.
A STUDY OF THE RADIAL DEPENDENCE OF THE RESIDUAL INTERACTION: THE OCTUPOLE COLLECTIVE STATES IN THE Sn AND Zr ISOTOPES
J. Rizek and P. Vogel May 1968 12 p
(UJV-2024) Avail: CFSTI

The energies and transition probabilities of the low-lying $I^{\pi} = 3^-$ states in the Sn and Zr isotopes are calculated by the Random Phase Approximation (RPA) method. Three different types of residual interaction are used: the octupole–octupole force, the surface δ–interaction and the usual δ–interaction. The results are practically independent of the type of the residual interaction used. The conclusion is made that the main characteristics of the collective state are independent of the radial form of the residual interaction. Author (NSA)

N69-23155# California Univ., Berkeley. Lawrence Radiation Lab.
KAON SPECTRUM AND DIFFRACTION DISSOCIATION EFFECTS (INCLUDING A_1)
Gerson Goldhaber June 1968 40 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-18316; Conf-680428-6) Avail: CFSTI

A review is given for the K^* spectrum and diffraction dissociation effects. A survey of the K^*'s, including reactions leading to K^* production, the Q peak and $K^*(1420)$, structure in the Q peak, spin and parity of the Q peak, and comparison with the quark model are covered. Also the next K^* cluster, evidence for an enhancement in the ΔN mass distribution, and the A_1 and the general A enhancement including A_1 production outside a diffraction dissociation peak, and resonance versus the Deck effect are discussed. J.F.P.

N69-23164# Atomic Energy Board, Pretoria (South Africa)
HIGH RESOLUTION FAST NEUTRON CROSS-SECTIONS OF IRON
E. Barnard, J. A. M. de Villiers, C. A. Engelbrecht, D. Reitmann, and A. B. Smith (Argonne Natl. Lab., Ill.) Jul. 1968 35 p refs Submitted for publication Supported by AEC
(PEL-190) Avail: AEC Depository Libraries

The interactions between Fe and neutrons with energies between 0.3 and 1.5 MeV were studied using time-of-flight methods. Particularly, the total and inelastic scattering cross sections were determined with good energy resolution; and a considerable amount of structure was observed. The results were investigated in terms of various theoretical approaches. Author (NSA)

N69-23172# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica
INTRODUCTION TO RADIATION PHYSICS, CHAPTER 9, PART 1 [INTRODUZIONE ALLA FISICA DELLA RADIAZION, CAPITOLO 9, PARTE 1]
U. Amaldi, Jr. 6 Sep. 1968 94 p refs In ITALIAN; ENGLISH Summary
(ISS-68/26) Avail: CFSTI

The three main phenomena through X and γ quanta interact with matter are discussed: photoelectric effect, Compton effect, and pair production. After a presentation of the energy behavior of the cross sections and of the energy spectra of the associated corpuscular radiation, attenuation coefficients are introduced, and attenuation measurements in good geometry are described. Author

N69-23180# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
HIGH-FREQUENCY POLARIZATION OF ATOMIC HYDROGEN BEAM. MEASUREMENT OF THE POLARIZATION COEFFICIENT OF PROTONS
J. Mares Jul. 1968 23 p refs
(UJV-2039) Avail: AEC Depository Libraries

The polarization of protons takes place by the high-frequency transition between Zeeman levels of atomic hydrogen by using the adiabatic passage method. The polarization coefficient can be found by measuring the beam instensity. In this stage of development, in which it is not possible to test the apparatus by nuclear reactions, intensity measurement methods are the only ones, which permit the beam parameters and function of the apparatus to be judged from qualitative and quantitative aspects. It was found that the method best suited for the determination of the polarization of protons in the hydrogen beam at relatively great distances from the dissociator is the modulated beam method. Some parameters of polarized ion source, which is under construction are also mentioned. Author (NSA)

N69-23181# Institut Fiziki Vysokikh Energii, Serpukhov (USSR)
ON SEARCHES FOR HEAVY LEPTONS [O POISKAKH TYAZHELYKA LEPTONOV]
S. S. Gershtein and V. N. Folomeshkin 1967 18 p refs In RUSSIAN
(IFVE-STF-67-57-K) Avail: AEC Depository Libraries

Various possibilities of heavy lepton production are discussed assuming that leptons participate in the electromagnetic and universal weak interactions only. It is noted that under these assumptions the negative results of the search for a heavy electron do not forbid a possible existence of a heavy electron with mass more than 500 MeV. An attempt is made to estimate the lower bound of the mass of the heavy muon (participating in the weak interaction with muonic neutrino or antineutrino) using the published results of the neutrino experiments in the CERN heavy liquid bubble chamber. Author (NSA)

N69-23182# Joint Inst. For Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
PHASE-SHIFT ANALYSIS OF ELASTIC p-p SCATTERING AT AN ENERGY 635 MeV AND INELASTIC INTERACTION CROSS SECTIONS
R. Ya. Zul'karneev, V. S. Kiselev, V. S. Nadezhdin, and V. I. Satarov 1968 18 p refs In RUSSIAN
(JINR-P1-4155) Avail: AEC Depository Libraries

The results of the phase-shift analysis, performed at an energy 635 MeV are presented. The experimental data obtained for the energy range of 635–650 MeV were analyzed. There were obtained several solutions under various assumptions on the meson production. On the basis of the analysis results it was determined that the meson production from $^1D_2$ states is equal to (15–8)10^{-27} cm^2. The contributions into the meson production from ^3P– and ^1F–states are approximately equal and come to (3–9)10^{-27}cm^2 for various sets. The obtained results are compatible with the assumption on the lack of separation of pions with respect to the subsystem of two nucleons. Author (NSA)

N69-23212# Ceskoslovenska Akademie Ved, Rez.
DETERMINATION OF RADIOCERIUM IN FISSION PRODUCTS MIXTURE BY REVERSED PHASE PARTITION CHROMATOGRAPHY WITH DI(2-ETHYLHEXYL) PHOSPHORIC ACID
J. Krtil, M. Bezddek, and J. Mencl Apr. 1968 9 p refs
(UJV-1978) Avail: AEC Depository Libraries

The radiocerium (IV) was extracted from 5M nitric acid and 0.5 M sodium bromate on a column of siliconized kieselguhr Chromosorb W saturated with the bis(2-ethylhexyl)ester of phosphoric acid (10% wt). The sorbed cerium was reduced and eluted from the column by a mixture of 5M HNO_3 + 0.1M ascorbic acid and then was γ-counted. The interfering influence of the activity of radioruthenium was removed by its transformation to nitro–nitroso ruthenium (III) complexes, which passed through the column. ^{95}Zr–^{95}Nb, which was also sorbed with cerium on the column, was not eluted by 5M HNO_3 + 0.1M ascorbic acid. The yield of isolation of radiocerium was >99.5% and the total accuracy of its determination was ±1.5% relatively. Author (NSA)

N69-23213# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
PROBLEMS OF PARTICLE MOTION IN ADGESATOR
I. N. Ivanov, M. L. Iovnovich, A. B. Kuznetsov, Yu. L. Obukhov, K. A. Reshetnikova et al 1968 24 p refs In RUSSIAN
(JINR-P9-4132) Avail: AEC Depository Libraries

A system, designed for production of charged bunch, is one of the components of collective ion acceleration. Self-consistent motion of particles in such a system, called adgesator, is considered. Necessary parameters of the ring bunch and its motion are calculated. Author (NSA)

N69-23214# Joint Inst. For Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
VIOLATION OF THE CP-INVARIANCE IN K-MESON DECAYS
S. M. Bilen'kii 1968 25 p refs In RUSSIAN
(JINR-P2-4129) Avail: AEC Depository Libraries

The problems of the CP–invariance violation in the decays of neutral K–mesons are reviewed. Phenomenological questions are mainly discussed. Effective equation for the system, described by superposition of K^0 and $\bar{K}^0$ states, is discussed. The $K_L \to 2\pi$ decays and the lepton decay of K_L–mesons are considered as well as the model of superweak interaction. Author (NSA)

N69-23228# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
THREE-PARTICLE INTERACTIONS AT HIGH ENERGIES
I. Z. Artykov 1968 9 p refs In RUSSIAN
(JINR-P2-4176) Avail: AEC Depository Libraries

The energy dependence of the many-particle interaction probability is studied by the example of inelastic interactions of three nucleons. This dependence if defined, in general, by the total energy in the cms and, at fixed energy, changes weakly with the energy change of one of the colliding particles. Author (NSA)

N69-23229# Wroclaw Univ. (Poland). Lab. of Theoretical Physics.
FIELD OPERATOR FOR INTERACTING UNSTABLE ELEMENTARY SYSTEM
J. Lukierski Dubna, USSR JINR 1968 9 p refs Presented at Balaton Seminar on Hadrons, Keszihely, Hungary, 6–11 Sep. 1968
(JINR-E2-4149) Avail: AEC Depository Libraries

The field operator $\phi^{(s,s)}_{La}$ describing an interacting unstable elementary system is introduced. Asymptotic fields are represented by free fields with continuous additional parameter. There is achieved the consistency with Haag–Ruelle theory of asymptotic states. Author (NSA)

N69-23238# Oak Ridge National Lab., Tenn. Office of Language Services.
ATTENUATION OF SCATTERED RADIATION FROM A SYNCHROCYCLOTRON IN THE SHIELD
L. N. Zaitsev et al [1968] 7 p refs Transl. into ENGLISH of Russian Rept. JINR-P9-3435
(ORNL-tr-2030; JINR-P9-3435) Avail: CFSTI

Calculated and measured data on neutron attenuation in hematite and ordinary concrete shielding are presented. The neutron flux was measured in concrete blocks located in the yoke of the magnet of the OIYal synchrocyclotron. NSA

N69-23240# Los Alamos Scientific Lab., N. Mex.
RESONANT FINAL STATE INTERACTIONS IN He 3 (d, tp) H 1, H 2(t, tp) n, AND H 3(d, tp)n REACTIONS
R. W. Newsome, Jr. 25 Nov. 1968 28 p refs
(Contract W-7405-ENG-36)
(LA-3997) Avail: CFSTI

A kinematically unique two-parameter experiment was used to search for resonant interactions between pairs of particles in the three-body final states of the reactions studied. The center of mass excitation range was from 20.5 to 29.3 MeV above the ^{4}He ground state for the t + p system, and from 21.0 to 29.1 MeV above the ^{4}He ground state for the t + n system. The reaction ^{3}He(d,tp)^{1}H with 15–MeV incident deuterons yielded a distinct resonance in the t + p system at 21.5 ± 0.1 MeV, with a width of approximately 1 MeV. Data from the reaction ^{3}H(d,tp)n, which were obtained with 20–MeV incident deuterons, are also consistent with the existence of a broad resonance in the t + p system at approximately 22 MeV above the ^{4}He ground state. The reaction ^{2}H(t,tp)n was run with 21–MeV tritons; however, the breakup spectra are unfortunately dominated by phase space and the spectator pole-type breakup of the deuteron. Author (NSA)

N69-23241# California Univ., Los Angeles. Dept. of Physics.
[ON PARTICLE PHYSICS] Annual Progress Report, 1 Jun. 1967–31 May 1968
1 Jun. 1968 41 p refs
(Contract AT(11-1)-34)
(UCLA-34-P-106-27) Avail: CFSTI

Experimental work in progress on the $n + p \to \gamma + d$ and $\pi + p \to n + \gamma$ interactions is described, and completed work on various K decays is reviewed. Also reviewed are the operation and performance of the high-energy radiation detectors used. NSA

N69-23242# Lockheed Missile and Space Co., Palo Alto, Calif.
MEASUREMENT OF PROTON AND NEUTRON SPECTRA ON COSMOS SERIES SATELLITES
V. E. Dudkin et al. 1968 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 887–891
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The flux and energy spectra of heavy charged particles and neutrons at 200 to 400 km altitudes, as obtained by nuclear emulsion stacks, are analyzed. The stacks were clamped in sealed compartments of the satellites and also embedded within polyethylene spheres of varying radii in order to investigate radiation attenuation and storage in tissue equivalent materials. Charged particle tracks with a $\pm$ 10° angle of insertion were selected for the measurements; proton energies up to 50 MeV and in the 50 to 400 MeV range were determined, as well as those exceeding 400 MeV. The results indicated nonuniformity in dose distribution over the depth of the substance, as well as the fact that increasing the shielding filter causes a noticeable decrease only in the surface dose. It was also seen that protons with energies less than 400 MeV yield the main contribution to the surface dose because of the slight filter thicknesses. Neutron energy distributions were obtained under the same conditions, and their flux rates at various energy levels are presented.
A.C.R.

N69-23249# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
POLARIZATION TRANSFER BY MEANS OF MAGNETIC INTERACTION OF NUCLEI IN MONOCRYSTAL
A. I. Vdovin, M. I. Podgoretskii, and S. K. Smirnov 1968 15 p refs In RUSSIAN
(JINR-P4-4146) Avail: AEC Depository Libraries

The behavior of the spin system in the external electric and magnetic fields near the crossing points of the energy levels is considered. In particular, the peculiarities of this behavior at fast and slow change of the magnetic field, in connection with the spin reorientation, are analyzed. The case for two spins is considered in detail and generalization is made for the case of any number of interacting spins.
Author (NSA)

N69-23251# California Univ., Riverside.
[ON PARTICLE PHYSICS] Annual Progress Report
W. H. Barkas May 1968 24 p refs
(Contract AT(11-1)-34)
(UCR-34-P-107-68) Avail: CFSTI

Bubble chamber and emulsion work that has been carried on during the past year is described. Some work has been done on a total of eight programs as follows: three-pion decay of the K^+ meson, negative K meson interactions in emulsions, high-energy π^+p interactions, K$^-$p interactions, high-energy electromagnetic processes, high-energy pp scattering, inelastic π^+p scattering in the 1900 MeV resonance region, and formalism for partial wave analysis of the process $0^- + 1/2^+ \rightarrow 3/2^+ + 0^-$.
Author (NSA)

N69-23254# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
EXPERIMENTAL INVESTIGATION OF THE DEVELOPMENT OF ELECTRON-PHOTON SHOWERS AT AN ENERGY FROM 1 TO 2 GEV
Z. Ognjevalski and Z. S. Strugalski 1968 26 p In RUSSIAN
(JINR-P1-4077) Avail: AEC Depository Libraries

The electron-photon showers, produced by γ-quanta in liquid xenon, are being investigated with the help of the xenon bubble chamber of the JINR Laboratory of High Energies. Information is obtained about the average shower characteristics at the primary γ-quantum energies of 1000, 1500, and 2000 MeV.
Author (NSA)

N69-23255# Ceskoslovenska Akademie Ved, Rez.
ANOMALOUS CAPTURE OF THERMAL POLARIZED NEUTRONS IN PERFECT FERROMAGNETIC SINGLE CRYSTALS
R. Michalec, V. Stich, D. Galociova, B. Chalupa, and J. Bischof Sep. 1968 6 p refs
(UJV-2080-F) Avail: AEC Depository Libraries

The effect of the electronic shell of atoms on the capture of thermal polarized neutrons by nuclei arranged in the lattice of perfect ferromagnetic single crystals was investigated.
Author (NSA)

N69-23256# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
ON THE KINETIC ENERGY VARIATION OF THE FRAGMENTS OF 235U FISSION BY 0.006 TO 20-eV NEUTRONS
S. Bochvarov, E. Dermendzhiev, and N. Kashukeev 1968 29 p refs In RUSSIAN
(JINR-P3-4110) Avail: AEC Depository Libraries

The kinetic energy variation was studied for the thermal range and for the resonances of ^{235}U by the method of measuring the relative yield of W fragments from two targets of different thickness using the neutron spectrometer of the Neutron Physics Laboratory (JINR) in the energy range 0.006 to 20 eV. It was found that the resonances at 0.29, 2.04, 3.14, 4.84, and 7.09 eV can be separated into the group with smaller values of W and respectively, E_k, while resonances at 1.14, 3.60, 6.40, 8.78, 12.4, and 19.3 eV form the group with larger W and E_k. The comparison of the values with the radiochemical data on the fission fragment yield in the thermal range and in ^{235}U resonances shows that, evidently, E_k is larger in more asymmetric fission. From the values $\overline{W}(I)$ and $\overline{W}(II)$ for two resonance groups, the variation of the average total kinetic energy of the fragments was found to be $\Delta\overline{E} = 0.74 \pm 0.32$ MeV.
Author (NSA)

N69-23257# Brookhaven National Lab., Upton, N. Y.
CROSS SECTIONS FOR THE RADIATIVE CAPTURE OF FAST NEUTRONS BY 74GE, 133CS, AND 192OS
V. A. Tolstikov, V. P. Koroleva, V. E. Kolesov, and A. G. Dovbenko 1967 10 p refs Transl. into ENGLISH from At. Energ. (Moscow) v. 23, 1967 p 576–580
(BNL-TR-240) Avail: CFSTI

The cross sections for the radiative capture of 0.2- to 3-MeV neutrons by ^{133}Cs, ^{74}Ge, and ^{192}Os were measured using end-window β counters to register the induced activities. The reaction T(p,n) ^3He was used as the neutron source, and a ^{235}U fission chamber was used to monitor the neutron flux.
NSA

N69-23259# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
A MODEL OF MAXIMAL CP VIOLATION
S. Okubo 3 Oct. 1968 16 p refs Presented at the Conf. on Hadron Spectry., Keszthely, Hungary, Sep. 1968
(Contract AT(30-1)-875)
(UR-875-259; CONF-680927-2) Avail: CFSTI

A model of maximally CP-violating Hamiltonian for weak interactions is formulated. It is assumed that weak intermediate vector mesons exist and are members of a unitary nonet or octet of Yang–Mills type. Also, the weak interaction Hamiltonian has CP = 1. It is shown that the first order effect in the semi-weak coupling constant g without andy real W-meson emission or absorption is zero due to the conservations of Q_w and Y_w quantum numbers of W-mesons.
NSA

N69-23261# Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Problems.

REMARKS ON THE ELECTROMAGNETIC INTERACTIONS OF K^0_{LS} MESONS

L. I. Lapidus 1968 8 p refs In RUSSIAN; ENGLISH summary (JINR-P2-4047) Avail: AEC Depository Libraries

Three remarks are discussed on the electromagnetic interaction of K^0_{LS}-mesons. The first two remarks refer to K^0_L-meson regeneration on electrons. The contribution of regeneration on electrons can be observed when the value and the sign of the lepton asymmetry in K^0_{l3} decays after the regenerator are observed. It is known that the electromagnetic interaction causes $K_2 \rightarrow K_1$ transitions but does not make any contribution (in e^2-approximation) to the $(K^0_{1,2}) \rightarrow (K^0_{1,2})$ transitions. (Here $K^0_{1,2}$ are understood as eigenstates of the CP-parity.) In violating the CP-invariance K_{LS} becomes physical states instead of $K^0_{1,2}$. Then we have not only $K^0_{LS} \rightarrow K^0_{LS}$ transition but also $K^0_{LS} \rightarrow K^0_{LS}$ K_{LS} transitions whose amplitude (in e^2-approximation) is 10^{-3} of the nondiagonal transition amplitude. Detailed formulae for the general case, when CPT-invariance is valid, and when T-invariance is valid are given. Author (NSA)

N69-23264# Akademiya Nauk URSR. Kiev. Institut Teoreticheskoi Fiziki.

CALCULATION OF FREE ENERGY FOR THE MODEL SYSTEM WITH FOUR-FERMION PAIR INTERACTION FOR SYSTEMS WITH REPULSION

N. N. Bogolyubov, Jr. 1968 11 p refs Presented at 2nd Conf. on Statist. and Phys. Kinet., Kiev, Sep. 1968 (ITF-68-65) Avail: AEC Depository Libraries

The model problems of superconductivity theory, as was shown by N. N. Bogolyubov, are among them. Bogolyubov has studied the problem of evaluating, at zero temperature, the ground-state energy and correlation functions asymptotically exact as $V \rightarrow \infty$. An essentially new step was made by developing an asymptotic method of calculation of free energy for BCS-type systems, a method suitable for any temperatures. However, the problem of constructing an asymptotically exact solution for the model with four fermion pair interaction corresponding to electron repulsion near the Fermi surface was open so far. The latter is determined by the condition of minimum of the free energy calculated for the approximation Hamiltonian. However, the minimum of such a function of C can exist only for the negative four fermion interaction. If the BCS-type interaction is positive, the free energy, considered as a function of the parameter C possesses no absolute minimum. A different approach to the problem is discussed. Author (NSA)

N69-23265# California Univ., Riverside.

HIGH ENERGY PHYSICS Annual Report

P. E. Kaus and B. R. Desai Jun. 1968 54 p refs (Contract AT(11-1)-34) (UCR-34-P-107-73) Avail: CFSTI

Theoretical research on Regge pole theory for hadron interactions and production, under AEC contract AT(11-1)34 P107A at the University of California, Riverside, is reviewed. NSA

N69-23267# California Univ., Berkeley. Lawrence Radiation Lab.

INFLUENCE OF SHIELDING ON THE NEGATIVE-MASS EFFECT

I. N. Ivanov 1967 18 p refs Transl. into ENGLISH from Russian Report JINR-P9-3476-2 (UCRL-Trans-1370; JINR-P9-3476-2) Avail: CFSTI

The effect of the conducting surface on the development of instability of the negative mass type was investigated for the case of infinite completely charged cylinders with azimuthal current, surrounded by metallic jacket. It was shown that the screening decreases the increments of growth of the instability. Author (NSA)

N69-23269# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

RESONANCE PRODUCTION IN POSITIVE PIONS p INTERACTIONS AT 2.34 GeV/c LEADING TO THREE-PARTICLE FINAL STATES

N. S. Angelov, I. M. Gramenitskii, Kh. M. Kanazirski, A. M. Moiseev, L. A. Tikhonova et al 1968 30 p refs In RUSSIAN (JINR-P1-4097) Avail: AEC Depository Libraries

Quasi two-particle reactions in $\pi^+ - p$ interactions at 2.34 GeV/c, leading to the three-particle final states, are being discussed. The cross sections of the $\pi^+ p \rightarrow \rho^+ p$, $\pi^+ p \rightarrow N^{*++}_{1238}\pi^0$ and $\pi^+ p \rightarrow N^{*+}_{1688}\pi^+$ reactions have been obtained. Author (NSA)

N69-23271# Paris Univ., Orsay (France).

THREE BODY RESONANCES

J. L. Basdevant and R. Omnes Jul. 1968 22 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna, 28 Aug.–5 Sep. 1968 (IPNO/LA-68/22; Conf-680809-34) Avail: AEC Depository Libraries

It is shown that a pseudo-relativistic three body theory derived on the basis of the Faddeev equations can be used to study three body resonances when the decay products resonate by pairs. The main virtues of the method, besides its simplicity, consist in having three body unitarity built in and in treating two body resonances as such in particle + resonance scattering. The limitations of the theory are discussed, and in particular it is shown that the ω meson cannot be examined in such a framework. A mechanism is explained, which can be responsible for the existence of the Δ resonances as well as many others in systems like $\pi\pi\pi$, $K\pi\pi$, and $KK\pi$, above 1 GeV. This mechanism is shown to have no relations with the Peierls mechanism which cannot give rise to these resonances. It is explained that the existence of an isospin two $\pi - \rho$ resonance at around 1300 MeV would be a very strong argument in favor of the theory. Author (NSA)

N69-23276 Rice Univ., Houston, Tex.

RICE UNIVERSITY STUDIES, VOLUME 54, No. 2: THE ALGEBRA OF REPRESENTATIONS OF SOME FINITE GROUPS

L. C. Biedenharn, W. Brouwer, and W. T. Sharp 1968 72 p refs

Copyright. Avail: Rice Campus Store, P. O. Box 1892, Houston, Tex. 77001: $2.25

A detailed collection of facts concerning cyclic, dihedral, dicyclic, and quantum degree of freedom groups (QF_p), and all other non-abelian, nondecomposable groups of order less than 32, are presented in tabular form. Some main points about group representation theory, including the algebra of representations, semidirect products, and induced representations, are briefly discussed. A summary table for the various groups serves as an index. P.A.B.

N69-23280# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.

MEASUREMENT OF ABSOLUTE ACTIVITY OF Ce-60 SOLUTIONS BY MEANS OF 4 PI BETA-GAMMA COINCIDENCE METHOD [MISURA DELL'ATTIVITA

ASSOLUTA DI SOLUZIONI DI CO-60 CON IL METODO DELLE COINCIDENZE 4 PI BETA-GAMMA]
A. Grisanti and P. Tori 16 Sep. 1968 29 p refs In ITALIAN; ENGLISH summary
(ISS-68/28) Avail: CFSTI

The apparatus and technique for high-precision $4\pi\beta$-γ coincidence counting are described. The method of preparation of a thin solid source of ^{60}Co for absolute activity measurement is discussed. Results of testing the accuracy and reproducibility of the counting apparatus are presented. Author

N69-23281*# Minnesota Univ., Minneapolis.
HIGH ENERGY PION-DEUTERON ELASTIC SCATTERING
R. C. Chase, E. Coleman, T. G. Rhoades, M. Fellinger (Iowa State Univ.), E. Gutman (Iowa State Univ.) et al 1968 10 p refs Presented at the 14th Intern. Conf. on High Energy Phys., Vienna, 1968 Supported in part by NASA and AEC
(COO-1764-18) Avail: CFSTI CSCL 20H

Measurements of π^-d elastic scattering at 3.75 GeV/c are presented, covering the range of four-momentum transfer $0.2 \leq |t| \leq 0.9$ $(GeV/c)^2$. The results of the Glauber high energy approximation including double charge exchange and the deuteron state are compared with the data. Author (NSA)

N69-23284# Zentralinstitut fuer Kernforschung, Rosendorf Bei Dresden (East Germany).
THE LINEAR ENERGY TRANSFER (LET) AS A BASIS FOR INTERPRETATION OF RADIATION BIOLOGY EXPERIMENTS
Heinz Rossbach Aug. 1967 132 p refs In GERMAN
(ZFK-128) Avail: CFSTI

The relation between absorbed radiation dose, LET distribution, and LET average values was calculated for various charged particles, fast neutrons, and photons of various energies were compared using water as the comparison medium. The applicability of these parameters to analysis of exponential survival curves on the basis of the hit-theory is discussed. The LET distribution was calculated for electrons, protons, deuterons, α particles, and C^{6+}, N^{7+}, and O^{8+} nuclei as a function of the particle energy by the Bethe formula and is given in the form of curves. The absorbed dose calculated by the Bethe formula for nuclei with energies greater than 2.4 keV, 70 keV, 3 MeV, 100 MeV, 150 MeV, and 200 MeV agreed with the measured values. For fast neutrons with energies between 1 and 20 MeV the LET distributions and LET average value for various limiting energies $\geq$0.1 keV for both the first collision and multiple collision cases. Author (NSA)

N69-23305# Paris Univ., Orsay (France). Lab. of Theoretical Physics and High Energies.
A DERIVATION OF THE HIGH-ENERGY UPPER BOUNDS OF RELATIVISTIC AMPLITUDES AT FIXED ANGLES (NOT EQUAL TO 0,Pi)
K. Chadan Oct. 1968 12 p refs
(LPTHE-TH-68/34) Avail: CFSTI

A derivation of the high energy, fixed angle, upper bound of relativistic elastic scattering amplitudes of two scalar neutral particles of equal mass is presented. NSA

N69-23306# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
INVESTIGATION OF THE At-211, Po-211, At-210, At-209, AND At-207 ALPHA SPECTRA WITH SEMICONDUCTOR ALPHA SPECTROMETER
L. Gueth, S. Gueth, E. Daroczy, B. S. Dzhelepov, Yu. V. Norseev et al 1968 13 p refs In RUSSIAN
(JINR-P6-4079) Avail: CFSTI

The α decay of the $^{211-209}At$, ^{207}At, and ^{211}Po isotopes was investigated. The energies and intensities of the α lines were measured. The probability of the ^{211}At and ^{209}At α decay and the half life of ^{210}At, ^{209}At, and ^{207}At were determined. Author (NSA)

N69-23307# Istituto Superiore di Sanita, Rome (Italy). Lab. di Physica.
DYNAMICAL INTERRELATION OF WEAK, ELECTROMAGNETIC AND STRONG INTERACTIONS AND THE VALUE OF θ
N. Cabibbo and L. Maiani 16 Oct. 1968 15 p refs
(ISS-68/35) Avail: CFSTI

An approach to hadron dynamics is described which includes the combined effects of weak and electromagnetic interactions. Symmetry breakings in the STRONG Hamiltonian are determined by weak and electromagnetic forces in a self consistent way. The effects of weak corrections, computed at second order with a cutoff $\Lambda(G\ \Lambda^2 \approx 1)$, coincide with those computed to all orders in a model with a neutral vector boson. A one parameter family of solution is found, depending on θ, and comparison with the observed breaking parameters leads to $\sin\theta \approx 0.22$. Author

N69-23316# Japan Atomic Energy Research Inst., Tokyo.
PROCEEDINGS OF THE FIRST SEMINAR ON NEUTRON CROSS SECTIONS
Jan. 1968 100 p refs In JAPANESE; ENGLISH summary
(JAERI-1171) Avail: CFSTI

The 1st Seminar on Neutron Cross Sections was held at the Tokai Research Establishment of the Japan Atomic Energy Research Institute on 15–17 February, 1968. About 80 scientists in the fields of nuclear physics and reactor physics participated in the seminar. The seminar was devoted to the discussion of the evaluation of nuclear data. Reviews on evaluation of nuclear data, several evaluation works, and critical works on evaluated data are reported. Author

N69-23346# Technische Hochschule Munchen (West Germany). Institut fuer Radiochemie.
CALCULATIONS FOR THE PREPARATION OF U-232 BY NEUTRON IRRADIATION OF A TH-230–TH-232 MIXTURE IN THE REACTOR
J. I. Kim and F. N. Flakus Mar. 1968 19 p refs In GERMAN
(BMwF-FBK-68-09) Avail: Depository Libraries

Calculations are made for the production of the isotope uranium 232 by reactor neutron irradiation of a thorium–ionium mixture. Special consideration is given to one special irradiation position of the FRM reactor. Effects of the neutron spectrum on the production of uranium 232 are considered. Following the results of calculations, a preliminary production scheme was prepared, and proper irradiation conditions are discussed. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-21964 Stanford Univ., Calif.
CYCLOTRON HARMONIC WAVE PROPAGATION AND INSTABILITIES
John Andrew Tataronis (Ph.D. Thesis) 1968 196 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-11361

A theoretical study of the electrostatic spacecharge waves which propagate in a hot plasma immersed in a constant and uniform magnetic field is presented. It is based on the self-consistent solution of the collisionless Boltzmann equation with Poisson's equation in infinite planar geometry and is restricted to interactions which involve only electrons. By considering a series of velocity distributions, a clear and comprehensive picture of the propagation characteristics and stability properties of these waves has been obtained. A study has been made on the analyticity of the Laplace transform of the electrostatic Green's function. The results show that instabilities associated with perpendicular propagation are absolute, while oblique propagation can support either absolute or convective instabilities, depending on the electron density and the distribution in electron velocity. Dissert. Abstr.

N69-21973 California Univ., Berkeley.
ENERGY TRANSFER PROCESSES AND REACTIONS OF TITANIUM TETRACHLORIDE IN AN INDUCTIVELY COUPLED ARGON PLASMA
Reid Clark Miller (Ph.D. Thesis) 1968 208 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-13938

A mathematical model is developed in Part I to predict temperature profiles in an inductively-coupled plasma torch. The model requires simultaneous numerical solution of the equation of energy and Maxwell's electromagnetic field equations, considering all properties to be temperature dependent and including radiation heat loss. The efficiency of power transfer from a standard line source to a radio-frequency plasma torch and the distribution of energy losses from such a plasma are investigated in Part II. Part III describes attempts to produce the lower chlorides of titanium, or the metal itself, by feeding titanium tetrachloride at low concentrations in argon to a radio-frequency plasma torch. In Part IV an approach to the calculation of the equilibrium composition for complex high-temperature systems is described. Dissert. Abstr.

N69-21974 Texas Univ., Austin.
ELECTROMAGNETIC WAVE PROPAGATION NEAR THE HYBRID ION-ELECTRON RESONANT FREQUENCY IN A CONTACT CESIUM PLASMA
Bernard Edward Breihan, III. (Ph.D. Thesis) 1967 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-10813

Experimental studies of electromagnetic wave propagation were carried out in a contact cesium plasma with particular interest centered on propagation near the hybrid ion-electron resonant frequency. Existing studies of this resonance were confined to nonlinear experiments in hydrogen, deuterium, and helium plasmas. In contrast the results from a linear experiment utilizing a low power Q-meter for the probing signal, thus insuring small amplitude perturbation, were carried out in a cesium plasma produced by contact ionization. The results are compared with a theoretical treatment which includes finite plasma effects, in particular the plasma length, the coil length, and the gap between the coil and plasma. This treatment predicts various extrema in the loading resistance of the plasma which can be classified as either intrinsic resonances which are found on the basis of an infinite plasma analysis or geometrical coupling resonances which are associated with the finite dimensions of the plasma. Dissert. Abstr.

N69-22006 Purdue Univ., Lafayette, Ind.
FREE-SPACE ELECTROMAGNETIC SCATTERING FROM A PLASMA COLUMN
Joseph Edward Butterworth (Ph.D. Thesis) 1968 290
Avail: Univ. Microfilms: HC $13.05/Microfilm $3.75 Order No. 68-12525

Laboratory measurements of electromagnetic scattering from the positive column of a low pressure (1.2 Torr) discharge in mercury under steady state conditions are described. Both amplitude and phase of the scattered electric field are measured for TE and TM polarizations over a 2.6 to 5.85 GHz frequency range. Two scattering experiments are performed for each of eight test frequencies in the above band: (1) a measurement of the scattered field versus discharge current at constant diffraction angle, which determines the resonant frequencies; and (2) a measurement of the scattered field versus diffraction angle at carefully chosen constant currents, which determines the angular variation of the various resonances. For each test frequency, the measured radar cross section of the plasma column with TE polarization is 20 decibels greater than that of a perfect conductor of the same radius. Dissert. Abstr.

N69-22031 Utah Univ., Salt Lake City.
THE DENSITY DISTRIBUTION OF A CYLINDRICAL PLASMA
Chao-Hung Ma (Ph.D. Thesis) 1968 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-14040

The theory of ambipolar diffusion for a d-c discharge plasma in a nonuniform magnetic field was analyzed, based on the assumption that the distribution function of the ions and electrons satisfies the collisionless Boltzmann equation. The theoretical plasma density profiles predict a plasma density peak in the increasing magnetic field region. A short microwave cavity was used to measure the relative axial density variations, and a comparison between experiment and theory gave reasonable agreement. A static theory of density and potential distribution in a cylindrical electron-beam-generated plasma with zero magnetic field was developed. Electron and ion density profiles were obtained, which show that the theory and experiment are in good agreement. A theory of ambipolar diffusion for a cylindrical beam-generated plasma in a uniform magnetic field was also derived. The relations between plasma density and the beam and the gas parameters were obtained and density profiles predicted; both microwave cavity and double probe measurements were conducted. A comparison between the results of this theory and experiment and some density measurements on beam-generated plasmas gives fair agreement. Dissert. Abstr.

N69-22079 Denver Univ., Colo.
NONLINEAR WAVE INTERACTIONS IN A HIGHLY IONIZED PLASMA
Jack Llano Boone (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-13706

The interaction of a large amplitude disturbing wave with a thermally generated, highly ionized cesium plasma was investigated, using a small amplitude sensing wave as a probe. Measurements of the sensing wave transmitted power were made using standard microwave techniques. A notch filter in the sensing wave receiving circuit reduced the scattered disturbing wave interference to an immeasurably low level. Langmuir probes were used to detect disturbing wave modulation and to measure plasma temperatures and densities. Measurements of the interaction were correlated with a solution of the Boltzmann transport equation for a perturbed Maxwellian distribution function with binary coulomb collisions. Dissert. Abstr.

N69-22134 California Inst. of Tech., Pasadena.
NONEXISTENCE OF LOOPING TRAJECTORIES IN HYDROMAGNETIC WAVES OF FINITE AMPLITUDE. BREAKING OF WAVES IN A COLD COLLISION-FREE PLASMA IN A MAGNETIC FIELD. ON STABILITIES OF PERIODIC WAVES IN A COLD COLLISION-FREE PLASMA IN A MAGNETIC FIELD
Tyan Yeh (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-13073

This dissertation consists of three parts. In part I, it is shown that looping trajectories cannot exist in finite amplitude stationary hydromagnetic waves propagating across a magnetic field in a quasi-neutral cold collision-free plasma. In Part II, time-dependent solutions in series expansion are presented for the magnetic piston problem, which describes waves propagating into a quasi-neutral cold collision-free plasma, ensuing from magnetic disturbances on the boundary of the plasma. In Part III, the existence of periodic waves propagating at an arbitrary angle to the magnetic field in a plasma is demonstrated by Stokes expansions in amplitude. Then stability analysis is made for such periodic waves with respect to side-band frequency disturbances. It is shown that waves of slow mode are unstable whereas waves of fast mode are stable if the frequency is below the cutoff frequency. The cutoff frequency depends on the propagation angle. Dissert. Abstr.

N69-22149*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEST PARTICLE METHOD IN KINETIC THEORY OF A PLASMA
Kyoko Matsuda Mar. 1969 30 p refs
(NASA-TM-X-63505; X-641-69-103) Avail: CFSTI CSCL 20I

A general relationship was found between many body correlation functions and the conditional probability functions which describe the shield clouds surrounding test particles. Based on the principle of superposition, the relationship is useful because the problem of kinetic theory is reduced to determining the conditional probability functions, which involves essentially only the Vlasov equation. This method was applied to obtain a second order correction to the Lenard-Balescu collison integral. Author

N69-22179*# Volt Information Sciences, Inc., Washington, D.C.
SCATTERING OF ELECTROMAGNETIC WAVES ON HYDRODYNAMIC PULSATIONS OF A TURBULENT PLASMA
V. G. Makhan'kov et al. NASA 24 Feb. 1969 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 12, no. 1, 1969 p 141-143
(Contract NAS5-12487)
(NASA-CR-100559; ST-EMWP-PP-10810) Avail: CFSTI CSCL 20I

Investigations were carried out on the scattering of high-frequency electromagnetic waves on small-scale wave turbulences caused by the presence in the plasma of electromagnetic fields and characterized by a wide assortment of various wave numbers. The interactions of high-frequency electromagnetic waves with specific oscillations existing in the region of frequent collisions were considered. A generalization is given of the results obtained for the interaction of transverse waves with longitudinal ones and also of transverse with transverse waves. In particular, the problem of scattering of transverse waves on low-frequency hydrodynamic turbulence is examined. B.G.D.

N69-22190*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EULER POTENTIALS AND THEIR APPLICATION IN THE HAMILTONIAN FORMULATION OF GUIDING CENTER MOTION
David P. Stern Mar. 1969 38 p refs
(NASA-TM-X-63504; X-641-69-97) Avail: CFSTI CSCL 20I

The representation of a magnetic field by the cross-product of the gradients of two scalars has recently seen wide use in plasma physics and in the study of energetic particles in space. The properties of such a representation are reviewed, and as an example of its application, the first-order guiding center motion of a charged particle in a time-independent magnetic field is derived in canonical form. Author

N69-22195*# Texas A&M Univ., College Station. Dept. of Physics.
A STUDY OF TRANSPORT PROPERTIES AND DISTRIBUTION FUNCTION DYNAMICS IN ONE DIMENSIONAL PLASMA MODELS Final Report
Jesse B. Coon 20 Mar. 1969 42 p refs
(Grant NGR-44-001-050)
(NASA-CR-100577) Avail: CFSTI CSCL 20I

The resonances in a one dimensional, two component, nonuniform sheath bounded plasma were studied. The numerical experiment was performed on a Univac 1108 computer, using a one dimensional charge sheet model system, driven by oscillating electric fields of various frequencies. The time varying current was Fourier analyzed to obtain the frequency dependence. No relation was found between the first resonance frequency and the average plasma frequency. The sheath strength appears to influence the resonances; the plasma behaves differently for a weaker sheath. Numerically exact solutions of the one dimensional Lenard-Balescu equation for drifted plasmas were also carried out. The computer program was developed on an IBM 7094; data were obtained from runs on a Univac 1108, and curves were plotted by the SC 4020. Detailed results of the study are discussed. The validity of the drifted distribution assumption and the effects of the wave particle interactions on the time development of the distribution function are examined. Investigations concerning the effects of gross spatial inhomogeneities on the growth rate of instabilities are also reported. P.A.B.

N69-22402# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
EXPERIMENTAL STUDY OF AN ION CYCLOTRON INSTABILITY IN A MAGNETIC WELL CONFINED PLASMA [ETUDE EXPERIMENTALE D'UNE INSTABILITE CYCLOTRONIQUE IONIQUE DANS UN PLASMA CONFINE DANS UN PUITS MAGNETIQUE]
Philippe Brossier (Ph.D. Thesis—Paris Univ., 7 Jun. 1968) Jan. 1969 174 p refs In FRENCH; ENGLISH summary
(CEA-R-3680; EUR-4110f) Avail: CFSTI

This report is a contribution to the study of microinstabilities in macroscopically stable plasmas, in the low-β limit. Ion cyclotron instabilities, with $k_{parallel} = 0$, have been numerically studied in detail and the computation of the density thresholds and growth rates of the different harmonics showed the relative role played by the following energy sources: density gradient, perpendicular distribution function and cold plasma component. This theoretical model has been compared with the results of a detailed study (density thresholds, wave structure, frequency spectrum, wavelength, growth rate, amplitude of the electric field) of the instability observed in the DECA II device. This comparison gave a good agreement which shows the destabilizing role played by the cold plasma component on a hot plasma with a loss cone distribution function. Author (ESRO)

N69-22437# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Strahlantriebe.
THERMODYNAMICAL PHASE DIAGRAMS OF ARGON IN THE STATE OF NONEQUILIBRIUM [THERMODYNAMISCHE

ZUSTANDSDIAGRAMME FUER ARGON IM THERMODYNAMISCHEN NICHTGLEICHGEWICHT]
U. Sprengel Oct. 1968 39 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-66) Avail: CFSTI

The thermodynamical phase of an argon plasma in the state of nonequilibrium is calculated and graphed in diagrams within the pressure range of 10^{-2} Torr to 10^{2} Torr. The electron temperature is assumed to be higher than the gas temperature within a factor of 1 to 2. Only single ionized argon is considered for temperatures from 2000°K to 15.00°K. Author (ESRO)

N69-22469# Institut fur Plasmaphysik G.m.b.H., Garching (West-Germany).
MEASUREMENTS OF THE DENSITY AND THE TEMPERATURE OF AN ARGON PLASMA JET BY MEANS OF A MACH-ZEHNDER INTERFEROMETER [MESSUNGEN DER TEMPERATUR UND DICHTE EINES ARGON-PLASMASTRAHLS MIT DEM MACH-ZEHNDER-INTERFEROMETER]
S. Witkowski Oct. 1968 15 p refs In GERMAN; ENGLISH summary
(IPP-3/80) Avail: CFSTI

The interferometric measurements and the evaluation of the local densities and temperatures in the outer regions of a plasma jet are described. Density and temperature profiles are given for a plasma jet with an argon mass flow of 0.14 m^3/h generated in an arc burner with a nozzle diameter of 7 mm and an arc current of 200 A. Author (ESRO)

N69-22470# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
THE RELAXATION OF HEAVY ION IMPURITIES IN AN ANISOTROPIC DEUTERIUM PLASMA
G. Lehner and F. Pohl Nov. 1968 21 p refs
(IPP-1/91) Avail: CFSTI

The relaxation of the anisotropy of impurity ions in an anisotropic plasma is discussed. The treatment is based on the assumption that all velocity distribution functions are elliptic initially and remain elliptic during the relaxation process. The problem thus reduces to a set of ordinary differential equations for the perpendicular and parallel temperatures of the different kinds of plasma particles. One may hope that such an approximate description of the relaxation is of some help in the interpretation of experimental results, as obtained by, for instance, Bogen et al. Some examples are treated numerically. Author (ESRO)

N69-22502# Commisseriat á l'Energie Atomique, Limeil (France).
CONTRIBUTION TO THE STUDY OF THE IONIZATION AND HEATING OF GASES BY LASER RADIATION [CONTRIBUTION A L'ETUDE DE L'IONISATION ET DU CHAUFFAGE DES GAZ PAR LE RAYONNEMENT D'UN LASER DECLENCHE]
Pierre Veyrie (Ph.D. Thesis—Paris Univ., 19 Jan. 1968) Dec. 1968 85 p refs In FRENCH; ENGLISH summary
(CEA-R-3472) Avail: CFSTI

The ionization and heating of gases by the concentrated radiation of a neodymium laser is studied. The power is 300 MW and the gas studied is primarily deuterium between 300 mm and 2280 mm. The first part concerns a certain number of experimental results on the absorption of the radiation and on changes produced in the plasma as a function of time. From these results are deduced a certain number of consequences, amongst which may be mentioned the definition of a pre-ionization threshold. These experimental results are interpreted in the second part and a calculation is made of the period of time required for the electrons to multiply such that the absorption becomes measurable. The last phase corresponds to the hydrodynamic evolution and the calculations are compared with the experiments. The agreement between theory and experiment is satisfactory for the different phases. Author (ESRO)

N69-22526# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
ANOMALOUS DIFFUSION AND OSCILLATIONS IN AN AFTERGLOW PLASMA
T. Dodo Nov. 1967 31 p refs
(IPP-2/65) Avail: CFSTI

Diffusion and oscillations of helium and neon plasmas have been examined in a glass chamber. The method of the experiment is the same as in the experiment in a metal chamber. The diffusion coefficient and the behavior of the oscillations in the plasma is quite the same as in the case of metal chamber. When $\omega_{ce}\tau_{en}<1$, there are no oscillations in the plasma density, and the diffusion is classical. When $\omega\tau>1$, oscillations appear in the plasma density and the diffusion becomes anomalous and 0.3 times Bohm diffusion. The shape of the fluctuation of the plasma potential is the same over the plasma volume and the fluctuating electric field is very small (< 0.2 mV/cm), when $\omega\tau<1$. When $\omega\tau\gg1$, the fluctuation of the plasma potential becomes turbulent and the amplitude of fluctuating electric field becomes large (≥ 3 mV/cm). Author (ESRO)

N69-22527# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
DETERMINATION OF THE ION ENERGY OF A DEUTERIUM PLASMA FROM THE ABSOLUTE NEUTRON YIELD IN A THETA-PINCH [BESTIMMUNG DER IONENENERGIE EINES DEUTERIUMPLASMAS AUS DER ABSOLUTEN NEUTRONENAUSBEUTE AM THETA-PINCH]
J. Sommer Oct. 1968 50 p refs In GERMAN; ENGLISH summary
(IPP-1/90) Avail: CFSTI

Part 1 of this report is intended for readers in a hurry as a separate section dealing with the principles of determining the ion energy of a deuterium plasma from the absolute neutron yield in a theta pinch. Anticipating the results of Part 2, it gives the error in the ion energy for various velocity distributions of the deuterons. Depending on the velocity distribution of the duterons, a certain experimental value <, the error of which was found to be ± 88% leads to the following bounds for the ion energy: 1) 2-dimensional Maxwell distribution : E = 4.2+0.71.1keV; 2) 3-dimensional Maxwell distribution : E = 5+0.81.2keV 3) 2-dimensional monoenergetic distribution: E = 6.1+0.81.3keV. Part 2 is concerned with the absolute determination of the total neutron number and the neutron rate. In particular, it describes in detail how the silver counter used for this purpose is calibrated directly by means of a neutron generator, allowance being made for the scattering of the neutrons in the laar I theta pinch device. Author (ESRO)

N69-22638*# United Aircraft Corp., East Hartford, Conn.
THEORETICAL INVESTIGATIONS OF r-f INDUCTION HEATED PLASMAS
Arthur E. Mensing and Laurence Boedeker Washington NASA Apr. 1969 79 p refs
(Contract NAS3-847)
(NASA-CR-1312; G-910091-18) Avail: CFSTI CSCL 20I

Theoretical analyses were made to investigate the power deposition and energy removal in radio frequency induction heated plasmas. These investigations were directed toward the high power, high pressure, radiating r-f plasmas that are being used to simulate

the thermal environment of the nuclear light bulb reactor. Two related investigations are described in this report. In one, the power deposition and energy dissipation characteristics of infinite-cylinder r-f heated argon plasmas at pressures of 1.0 and 10 atm were studied. The electromagnetic field equations, energy equation, and heat conduction equation were integrated numerically starting with specified values of temperature and axial magnetic field at the centerline. In the second investigation, the coupling between the plasma discharge and the r-f generator was studied using an infinite-cylinder, constant-conductivity model. The analysis was used to investigate the effects of discharge power, reactive power, and discharge size on the surface radiation heat flux and to examine the effect of r-f frequency shifts on matching. Author

N69-22895*# Avco-Everett Research Lab., Everett, Mass.
THE ROLE OF LANDAU DAMPING IN CROSSED-FIELD ELECTRON BEAMS AND INVISCID SHEAR FLOW
R. J. Briggs, J. D. Daugherty, and R. H. Levy Dec. 1968 77 p refs
(Contracts NASB-21392; AT(30-1)-3863; AF 49(638)-1553)
(NASA-CR-98387; RR-317) Avail: CFSTI CSCL 20I

The electron density, the drift velocity, and the potential correspond to the fluid vorticity, velocity, and the stream function respectively. The analogy is valid only for waves propagating in the direction of the unperturbed velocity. Neutrally stable normal modes of oscillation that are found when certain suitable step-function unperturbed electron density (vorticity) profiles are assumed seem to disappear when small gradients are present. In the context of a Laplace transform solution of the initial value problem, the vanishing normal modes can be found by analytic continuation of the solution onto another sheet of the cut complex ω-plane. The recovered modes are found to be damped by a fluid wave resonant interaction which closely resembles the Landau damping of plasma oscillations in warm plasmas by particle wave resonance. An interesting feature of the neutral waves is that they have a negative energy and so are destabilized by the removal of energy from the system (for example, by slightly dissipative walls). Author

N69-22920*# United Aircraft Corp., East Hartford, Conn.
EXPERIMENTAL INVESTIGATION OF THE SPECTRAL EMISSION CHARACTERISTICS OF ARGON-TUNGSTEN AND ARGON-URANIUM INDUCTION HEATED PLASMAS
Pierre J. Marteney, A. E. Mensing, and N. L. Krascella Washington NASA Apr. 1969 48 p refs
(Contract NASw-847)
(NASA-CR-1314; G-910092-001) Avail: CFSTI CSCL 20I

An experimental study was conducted to determine the emission characteristics of gaseous tungsten and uranium located in an r-f induction heated, vortex stabilized argon discharge. The tungsten and uranium were introduced into the discharge in the form of tungsten and hexafluoride or uranium hexafluoride at heavy atom to argon mass ratios and a total pressure of one atmosphere. Temperatures in the heavy atom seeded discharges were determined to be approximately 8500 deg K, and were ascertained by measuring neutral argon atom relative line intensity ratios by the Boltzmann method. Temperatures determined by this method were confirmed by measurements of absolute neutral argon atom line intensities and absolute argon ion continuum intensities. Spectra were obtained for pure argon, tungsten hexafluoride-argon, and uranium hexafluoride-argon systems in the wavelength region from 125 A (0.125 micron) to 100,000 A (10 micron). The experimental data were reduced to obtain integrated continuum and line intensities over intervals of 100 A for pure argon. Integrated line intensities were obtained over wavelength intervals of 100 A for tungsten and uranium after correcting the experimental results for the contribution to total intensity due to argon continuum and lines. Author

N69-22942*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INVESTIGATION OF A PLASMA ACCELERATOR WITH MAGNETIC FIELD ARRANGED TO PRODUCE A DIVERGENT-NOZZLE EFFECT
Joseph D. Brooks and William D. Beasley Washington Apr. 1969 32 p refs
(NASA-TN-D-5122) Avail: CFSTI CSCL 20I

The results of an experimental investigation of a plasma accelerator at static pressures from 0.765 mm Hg to 2.60 mm Hg are presented. The continuous flow device used a dc arc to provide the plasma and a dc magnetic field that is shaped to provide both the constriction of the plasma and the pressure gradient that produces the flow. Pressure measurements within a certain range of parameters were obtained. Effects of increased magnetic field strength, arc current, and pressure upon the Mach number are given. Author

N69-22999# Los Alamos Scientific Lab., N. Mex.
STABILITY OF SLOWLY TAPERED AXISYMMETRIC PLASMA FLOWS
B. R. Suydam 19 Dec. 1968 8 p refs
(Contract W-7405-ENG-36)
(LA-4034-MS) Avail: CFSTI

In experiments with a coaxial plasma gun, Marshall and others have observed what appears to be a steady flow of plasma accompanied by strong compression on the axis. Morozov and others have described theoretically steady axisymmetric flows which seem very similar to those observed. Analytic results are achieved by assuming the electrodes to be gradually tapered. The magnetohydrodynamic stability of such flows is discussed. The assumption of gradually tapered electrodes enables one to develop a variational technique. It was found the $m = 0$ mode generally to be unstable or stable accordingly as there is or is not shear in the flow. Kink ($m = 1$) modes are unstable. Author (NSA)

N69-23154# Atomic Energy Commission, Washington, D.C. Div. of Technical Information
THE MOTION OF TRANSIT PARTICLES IN A SYSTEM WITH A MINIMUM B
Yu. V. Skosyrev et al [1968] 9 p refs Transl. into ENGLISH from Akad. Nauk USSR, Report No. IAE-1488
(AEC-tr-7004) Avail: CFSTI

Particle in-flight motion in a system with helical magnetic axes and stablizing fields securing a minimum B was studied. Experimental data are presented for rotational transformation angle and drift surface configurations, and theoretical and experimental correlations are discussed. NSA

N69-23157# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
NONLINEAR LOW-FREQUENCY SPECTRA OF ANISOTROPIC PLASMA OSCILLATIONS
V. G. Makhankov 1968 11 p refs In RUSSIAN
(JINR-P9-4041) Avail: AEC Depository Libraries

Studies were made of the influence of Langmuir high-frequency turbulence on the low-frequency anisotropic plasma oscillations. Author (NSA)

N69-23211# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Inst.
INTERACTION OF MOVING PLASMA WITH AN OBLIQUE MAGNETIC FIELD [VZAIMODEISTVIE DVIZHUSHCHEISYA PLAZMY S KOSYM MAGNITNYM POLEM]
V. S. Voitsenya, I. N. Onishchenko, and B. G. Safronov 1968 15 p refs In RUSSIAN
(NP-17664) Avail: AEC Depository Libraries

The interaction of a moving plasma cluster in a magnetic trap with the magnetic field, when the plasma moves at an acute angle with respect to the direction of the field, presents an as yet unresolved problem. Such a situation arises when plasma streams are injected into a closed trap, as is the case of the stellarator or a trap with combined fields. The interaction of the plasma with its confining field may be mocked up by the interaction of plasma clusters with an oblique field. The problem was studied by using the drift approximation for analyzing the motion of the plasma in the oblique field; a transverse field applied onto the constant field of the solenoid was used to obtain a magnetic field directed at an acute angle with respect to the direction of the injection. The results indicated that in such an oblique field the plasma diverges from its original direction, creating cut-off plasma clusters. NSA

N69-23324# Laboratoire de Recherches Sur La Physique Des Plasmas, Lausanne (Switzerland).
ROTATING MAGNETIC FIELD PINCH
I. R. Jones, A. Lietti, and J-M. Peiry Jul. 1967 31 p refs
(IRP-31/67) Avail: CFSTI

Helium gas at a pressure of 60 mtorr is contained in a discharge tube of diameter 4.8 cm and length 49 cm which is equipped with end electrodes and is situated within a multiturn solenoid. The gas is preionized by means of an axial current pulse of 9.5 kamps amplitude and 32 μsec duration. Following the preionization pulse, two high-power rf generators, each capable of delivering pulses of 7 periods at a frequency of 3.10 Mc, are triggered. One generator produces an oscillating axial current in the preionized plasma while the other induces an oscillating azimuthal current. The generators are adjusted to give equal B_θ and B_z peak amplitudes at the inner wall of the discharge tube. When the two oscillating currents are dephased by 90°, the plasma experiences the continuous magnetic pressure exerted by a rotating field. Streak photographs show that the plasma separates from the tube wall and implodes towards the axis. Framing pictures show that cylindrical symmetry is maintained during this implosion. Author (NSA)

N69-23295# Kiel Univ. (West Germany). Institut fuer Experimentalphysik.
INVESTIGATIONS OF STRONG SHOCK-WAVES Status Report, Dec. 1967 [UNTERSUCHUNG VON STARKEN STOSSWELLEN. STAND: Dezember 1967]
O. E. Berge, W. Boetticher, H. Carls et al Jul. 1968 62 p refs In GERMAN; ENGLISH summary
(BMWF-FBK-68-29) Avail: AEC Depository Libraries

The status is reported of investigations of plane (membrane shock tube, $M \leq 15$) and convergent cylindrical shock waves (Z pinch, $M \leq 100$) and the connected diagnostic methods. The electron density is determined by optical and microwave interferometers. The shock front velocity is measured by a laser-schlieren method and by the Doppler effect of microwaves. Finally, different methods for the calculation of the partition function of diatomic molecules are compared. Author (NSA)

N69-23313# Los Alamos Scientific Lab., N. Mex.
STATIONARY AXISYMMETRIC FLOW OF A HOT PLASMA
B. R. Suydam 6 Dec. 1968 12 p refs
(Contract W-7405-ENG-36)
(LA-4015-MS) Avail: CFSTI

A study was made of the axisymmetric flow of a hot plasma, using the magnetohydrodynamic model of Chew, Goldberger, and Low. Certain types of flow are found to produce strong compression and high temperature. The Chew, Goldberger, Low model is shown to predict the same compression, but slightly lower temperature, than does the γ-law ideal gas model. Author (NSA)

N69-23328# Los Alamos Scientific Lab., N. Mex.
OPTIMIZATION OF THE INTEGRAL OF dl/B STABLE REGION IN A LINEAR QUADRUPOLE
D. A. Baker and J. P. Freidberg Feb. 1968 7 p refs
(Contract W-7405-ENG-36)
(LA-4017) Avail: CFSTI

Analytical calculations are made of the stable flux in a linear quadrupole. Curves are given for determining the conductor spacing that, for a given plasma temperature, maximizes the number of ion gyro-radii across the stable field region when the design is subject to constraints on the force, injection field, field energy, and current. Author (NSA)

N69-23333# Princeton Univ., N. J. Plasma Physics Lab.
APPLICATION OF THE ENERGY PRINCIPLE TO ASTRON-TYPE AND OTHER AXISYMMETRIC DEVICES
John L. Johnson, Russel M. Kulsrud, and Katharine E. Weimer Dec. 1968 19 p refs
(Contract AT(30-1)-1238)
(MATT-653) Avail: CFSTI

The stability of Astron-type devices is investigated on the basis of a model in which the electrons in the E-layer are assumed rigid. It is shown that stability is given by the usual energy principle provided that the current density is replaced by the plasma current density. The theory of general axisymmetric systems of Bernstein et al. is extended to include this model, and the stability criterion is found to be given by a slightly modified second-order eigenvalue equation along the closed lines. In the very low pressure limit the stability criterion is that $V'' < 0$. An expression for the critical pressure for ballooning modes is found in the next order in an expansion in pressure. The differential equation is solved numerically for explicit Astron-type configurations. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-21961 Pennsylvania State Univ., University Park.
SOME OPTICAL, DIELECTRIC, PHOTOCONDUCTIVE AND PHOTOLUMINESCENT PROPERTIES OF GEL GROWN LEAD IODIDE SINGLE CRYSTALS
Allan Edward Dugan (Ph.D. Thesis) 1967 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-11981

In studying the defect energy level structure within the forbidden band gap, the dielectric constant (K') and loss (K'') were determined as a function of temperature (120°K to 450°K) and frequency (10^2 to 10^5 Hz). A reliable value of the intrinsic dielectric constant appears to be K' = 6.21; irradiation with light of a wavelength corresponding to the absorption edge showed an effect on both K' and K'' which was determined to be a photocapacitive phenomenon. The index of refraction was determined in the wavelength range 0.5 - 15 μ at 2.56 ± 0.02. Optical absorption measurements in the region of the fundamental absorption edge showed that the absorption coefficient varied exponentially with incident photon energy, while optical transmission studies with polarized light indicated that the absorption edge for E ∥ c was positioned 0.048 eV above the edge for E ⊥ c. Thermal electric probe analysis indicated that the majority carriers in the dark current were holes and were temperature dependent.

Photoconductivity as a function of wavelength of the exciting radiation was found to show features in the photoresponse spectrum at 1.99, 2.16, 2.41, and 3.06 eV, and photoluminescent measurements revealed radiative transitions corresponding to energies of 2.41, 2.31, 2.16, 2.13, 2.10, 1.99, 1.97, and 1.94 eV. Interpretation of the above results confirmed the proposed model of the valence band structure for PbI_2 and enabled formulation of a model of the defect level structure. Dissert. Abstr.

N69-21966 Stanford Univ., Calif.
THEORETICAL INVESTIGATIONS OF DENDRITIC GROWTH
Gerald Roy Kotler (Ph.D. Thesis) 1968 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-11315

An investigation is described of several aspects of dendritic growth which were poorly defined or totally unexplained. Problems explored were (1) the determination of the growth velocity and tip curvature for a dendrite growing into an undercooled, pure or binary alloy melt, using a semi-infinite, non-isothermal, paraboloid of revolution for the dendrite model; (2) analysis of the stability criteria for the dendrite stem, employing a right-circular cylinder as its physical representation and treating both pure and alloy systems; (3) a stability treatment of the paraboloid of revolution with major emphasis on the region near the tip. The results of the above investigations are summarized. Dissert. Abstr.

N69-21980 Colorado Univ., Boulder.
THE THERMAL CONDUCTIVITY OF DIELECTRIC CRYSTALLINE SOLIDS AT LOW TEMPERATURES
David Starling Dillard, Jr. (Ph.D. Thesis) 1968 335 p
Avail: Univ. Microfilms: HC $15.10/Microfilm $4.30 Order No. 68-14229

The theory of the thermal conductivity for these solids, composed of either ideal or actual crystals, was presented over the temperature range from 0°K to temperatures above the Debye temperature. The thermal conductivity of a few selected dielectric crystalline solids is measured experimentally in a specially designed cryostat. A detailed discussion is presented of the cryostat design for this research. Experimental thermal conductivity values for solid water, solid benzene, and solid nitrobenzene are presented over a temperature range from 80° to 273°K. Steady state measurements of the thermal conductivity are made using a cryostat with a guard shield arrangement over the sample chamber. This guard shield made it possible to obtain unidirectional flow of heat through the one inch sample and also to maintain a small temperature difference across the sample at all temperatures. Dissert. Abstr.

N69-21989 Cornell Univ., Ithaca, N. Y.
A CALCULATION OF PHONON LIFETIMES IN SOLID ARGON
Henry David Jones (Ph.D. Thesis) 1968 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-11629

Phonon lifetimes for solid argon crystals were calculated from first principles using the computer. The calculation assumes that the lifetime is caused exclusively by three phonon processes and that perturbation theory is adequate to describe their effect. Both Normal and Umklapp lifetimes are calculated assuming nearest neighbor coupling alone for k on the (100), (110) and (111) axes, $0.05 \leq ka/2\pi \leq 1$, and $4°K \leq T \leq 87°K$. In addition the calculations are repeated on the (100) axis assuming up to fourth-nearest neighbor coupling. It is found that the inclusion of non-nearest neighbor coupling can change lifetimes by a factor of two. It was found that the Umklapp relaxation time for longitudinal modes becomes infinite in the range $0.4 \leq ka/2\pi \leq 0.8$. This would indicate an anomalously large thermal conductivity at certain temperatures if taken at face value, but reasons are given for believing that the so-called Umklapp relaxation time has no well defined physical meaning. Dissert. Abstr.

N69-21992 California, Univ., Los Angeles.
THE SUPERCONDUCTING PROPERTIES OF METALLIC INDIUM ANTIMONIDE
Gary Lee Dorer (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-11863

Single crystals of metallic indium antimonide (InSbII) were grown under a pressure of 26 kbars and recovered at liquid nitrogen temperatures. X-ray Laue studies were made on these crystals to verify that they were indeed single. The magnetic properties of the superconducting state of InSbII were studied by making torque, magnetization, and resistance studies on these single crystals. It has been determined from the above studies that InSbII is a type II superconductor with an anisotropic upper critical field. The anisotropy in H_{c2} has been found to be approximately 50% at $T \sim 1.2°K$, ranging from 36 gauss for fields parallel to the tetragonal axis, to 60 gauss for fields perpendicular to the [001] axis. This anisotropy decreased to zero at T_c, which has been found to be in the neighborhood of 1.58°K. Dissert. Abstr.

N69-22009 State Univ. of New York at Buffalo.
A STUDY OF THE ESR IN TURBOSTRATIC AND PARTIALLY GRAPHITIZED CARBON BLACKS
George Miller Arnold (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.21/Microfilm $3.00 Order No. 68-115117

The electron spin resonance in heat treated carbon blacks was studied as a function of crystallite size in two ways: by using different particle size starting materials at a given heat treatment temperature and by taking two thermal blacks of large average particle size and heat treating them to various temperatures. The shift of the g-value from the free electron value is shown to be related to the mean crystallite diameter as well as to the average interlayer spacing for a range of carbon blacks all heat treated at 2900°C. Two thermal blacks, p33 and Thermax, were studied with emphasis on the range of HTT 1600-2400°C. The g-shift, line intensity (including the intensity at two ambient temperatures) and the line width are given for the range of heat treatment temperatures 1600-3000°C. The equivalent spin concentration for the 3000°C HTT samples was found to be approximately the same as the value for graphite. Dissert. Abstr.

N69-22028 New Mexico Univ., Albuquerque.
THE KINETICS OF PHASE TRANSITIONS IN SOLID CYCLOHEXANOL AND RELATED PLASTIC CRYSTALS
William Thomas Griffith (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-11657

The phase relations and the kinetics of phase transitions in the solid forms of cyclohexanol, cyclohexanone, chlorocyclohexane, bromocyclohexane, and cyclopentanol have been investigated. Cyclohexanol has been studied the most thoroughly; the other compounds have been considered largely for purposes of comparison with cyclohexanol. The primary methods of investigation have been the measurement of dielectric properties and visual observations. The transitions in cyclohexanol have also been followed photographically in order to measure the growth velocities of the phase interfaces. Dissert. Abstr.

N69-22068 Rensselaer Polytechnic Inst., Troy, N. Y.
THE AGING PHENOMENON IN BARIUM TITANATE

Richard Carl Bradt (Ph.D. Thesis) 1967 206 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-13505

Ferroelectric domain structure and domain boundary characteristics were observed by transmission electron microscopy. The results of these observations were combined to yield a description of the mechanism of the aging process. Aging may be described as the thermally activated nucleation of 90° domains at regions of high internal stress. It is the reduction of these residual internal stresses from the ferroelectric transition, that results in the property changes observed during the aging process. Both 90° and 180° domain boundaries were observed by transmission electron microscopy. Structurally, a 90° domain boundary was estimated to be about 60 A° wide. Motion of 90° domain boundaries appeared to be smooth and continuous, no evidence of a dislocation mechanism of boundary motion was observed. Dissert. Abstr.

N69-22075 Columbia Univ., New York.
INTERNAL FRICTION STUDIES IN NICKEL CRYSTALS FROM 77°K TO 298°K
Peruvemba Swaminatha Venkatesan (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-11743

The internal friction spectrum in nickel single crystals was studied near 20 kHz from 77°F to 298°K as a function of the stages of deformation, crystal orientation, temperature of deformation, magnetic field and state of annealing. Plastic deformation produces two major peaks centered at 230°K (peak X) and 130°K (peak Y). Peak X grows throughout stages 1 and 2 and falls in stage 3. Peak Y occurs only in stage 3. The height of peak X when plotted against the flow stress resolved on the primary glide system is approximately a straight line in each of stages 1 and 2, with the slope in stage 1 probably higher than the slope in stage 2. The variation in the height of peak X with crystal orientation is consistent with the hypothesis that dislocations in the primary glide system are responsible for it. Peak Y shows a different dependence, for which there is no immediate explanation. Isochronal annealing (1/2 hour) in steps of 100°C showed two recovery stages, one between 25°C and 100°C, and the other between 320°C and 430°C. Dissert. Abstr.

N69-22095 Texas A&M Univ., College Station.
FLUCTUATION PHENOMENA IN IODINE
Garald Wayne Caruthers (Ph.D. Thesis) 1968 66 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-11444

An analysis of the noise in iodine was made. The spectral intensities were observed directly between 20 and 500 cps using a wave analyzer to provide the Fourier amplitudes. The spectral intensities between .025 and 10 cps were calculated from auto-correlation function that were obtained from photographs of oscilloscope traces. This analysis indicated considerable low frequency noise of the form V^3/f^2 with some structure at the lowest frequencies. There were large spatial and long time correlations present, and the noise increased exponentially with temperature. It was assumed that the noise was due to a breakdown phenomena. This phenomena could explain the increased noise and its temperature dependence. The extended carrier lifetime is thought to be the result of the excess charge filling the trapping centers. Dissert. Abstr.

N69-22112# California Univ., Berkeley. Lawrence Radiation Lab.
EMPIRICAL PSEUDOPOTENTIAL METHOD FOR ELECTRONIC BAND STRUCTURE CALCULATIONS IN INSULATORS
Ching-Yao Fong (Ph.D. Thesis) Jul. 1968 101 p refs
(Contract W-7405-ENG-48)
(PB-180839; UCRL-18356) Avail: CFSTI CSCL 20L

Electronic band structures are calculated by the 'Empirical Pseudopotential Method' for three ionic crystals: MgO, NaCl and KCl. The pseudopotential form factors of the first two crystals are determined by assuming the potentials are local. For the case of KCl, an additional angular momentum dependent nonlocal pseudopotential is introduced. The imaginary part of the frequency dependent dielectric function, epsilon sub 2 (omega), calculated from the band structure is directly compared to the measured ultraviolet spectrum. Apart from the excitonic structure, the agreement of the epsilon sub 2 (omega) between theory and experiment for the position in energy of the prominent structure is within 0.1 eV for photon energy less than 14.0 eV, and 1.0 eV for higher photon energy. There exists discrepancy between the magnitudes of the calculated and the measured peaks and this is discussed. The complete critical point analysis enables one to identify all the prominent structure in the epsilon sub 2 (omega). Author (USGRDR)

N69-22131 New Mexico State Univ., University Park.
THEORY OF THE LINEAR ELECTRO-OPTIC EFFECT IN KDP
Rama Yelundur Narasinga Rau (Ph.D. Thesis) 1967 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 67-12848

This paper presents a theory for the linear electro-optic effect in KDP (Potassium dihydrogen phosphate) based on the local fields in the crystal. The study of the local fields in crystals leads directly to the problems of calculating the Lorentz factors which depend on the geometry of the crystal. Born and Ewald have obtained an expression for the potential at any point in an infinite crystal lattice. From this we were able to obtain an expression for the Lorentz factors for an orthorhombic crystal lattice in terms of the dimensions of the unit cell. Since an examination of the crystal structure of KDP reveals that it is a superposition of tetragonal lattices, we were able to calculate the Lorentz factors for KDP. Dissert. Abstr.

N69-22152# Institute of Technology, Helsinki (Finland).
PHOTOCONDUCTIVITY OF HEXAGONAL SELENIUM SINGLE CRYSTALS
T. O. Tuomi (Ph.D. Thesis) 1968 40 p refs /*/ ACTA Polytech. Scand., Phys. Nucl. Ser. 56
(PB-180623; APS-PH-56) Avail: CFSTI CSCL 20L

A quantitative barrier model of the photoconductivity based on the ideas of Plessner and Stuke has been presented for selenium single crystals. Small angle boundaries have been discovered in the selenium single crystals with the aid of the Guinier-Tennevin method. The existence of the potential barriers most probably associated with the small angle boundaries has been proved indirectly by measuring phonon drag thermopower. This measurement gives support to the result obtained with other selenium crystals that in the temperature range from 80 to 300 degrees K the microscopic mobility of holes is predominantly determined by phonon scattering. The exponential temperature dependence of the d.c. conductivity mobility can thus be explained by potential barriers. From the thermoelectric power measurement the value of the hole concentration is evaluated and is then used in the determination of the photoconductivity parameters. Author (USGRDR)

N69-22908# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE THEORETICAL STUDY OF THE THERMAL DIFFUSION OF POINT DEFECTS IN METALS

[CONTRIBUTION A L'ETUDE THEORIQUE ET EXPERIMENTALE DE LA THERMODIFFUSION DE DEFAUTS PONCTUELS DANS LES METAUX]

Maurice Gerl (Ph.D. Thesis--Paris Univ., 13 Jan. 1968) Nov. 1968 79 p refs In FRENCH; ENGLISH summary
(CEA-R-3487) Avail: CFSTI

An experimental study of diffusion under a thermal gradient shows that the heat of transport for self-diffusion in the noble metals is very low (a few hundredths of 1 eV) and relatively large in Fe$_{Zr}$ (+1.7±0.8 eV). The apparent heat of transport of Sb in Cu, measured by the 'thin layer technique' is −0.21±0.05 eV. The influence of the density of sources and sinks of vacancies on the observed vacancy flux is determined by a calculation involving the thermodynamics of irreversible processes; when the mean distance between sources and sinks is larger than a certain limiting value, the vacancy flux vanishes. The contribution to the heat of transport of electron-defect (q*e) and phonon-defect (q*p) collisions is calculated using a semi-classical approach and a quantum mechanical method; q*e is related to the resistivity Δ_{pd} and to the thermoelectric power of the defect at its stable position and at its saddle-point. A relation between q*e and the effective valency Z* of the defect allows a determination of Δ_{pd} at the saddle-point. Numerical values of q*e are given for some impurities in noble metals. Author (ESRO)

N69-22552*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ANNEALING OF 22-, 40-, and 158-MeV PROTON DAMAGE IN n- AND p-TYPE SILICON

Marvin E. Beatty, III and Gerald F. Hall Washington Apr. 1969 26 p refs
(NASA-TN-D-5119) Avail: CFSTI CSCL 20L

Studies on n- and p-type silicon irradiated with 22-, 40-, and 158-MeV protons and annealed at 100°C, 200°C, and 300°C are reported. A fluence dependence was found for protons in which the annealing decreased as the fluence increased and was compared with results previously reported for electrons. Alternate increases and decreases in minority-carrier lifetime during isothermal annealing is discussed. Author

N69-22573*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

SIMPLIFIED THEORY AND TRANSDUCER POTENTIALITIES OF THE "PINCH EFFECT" IN SEMICONDUCTORS

Ernest E. Pitteli and Wilhelm Rindner Washington Apr. 1969 22 p refs
(NASA-TN-D-5130) Avail: CFSTI CSCL 20L

The recently reported electric pinch effect in anisotropic semiconductors is analyzed theoretically with emphasis on the underlying physical phenomena. The theory is generalized to apply to extrinsic semiconductors and to encompass effects in the direction transverse to stress and electric field. In extrinsic material the magnitude of the pinch effect is reduced by the ratio of minority to majority carriers. In the transverse direction a potential difference is generated by two essentially independent mechanisms: a highly surface-dependent diffusion caused by a stress-dependent concentration gradient of free carriers, and a surface-independent transverse piezoresistance. The potential and limitations in the utilization of the pinch effect for electromechanical transducers are examined. Author

N69-22810# California Univ., Berkeley. Radiation Lab.

INTERDIFFUSION IN NiO, CaO, AND MgO SINGLE CRYSTALS

Marvin Appel (Ph.D. Thesis) Jun. 1963 63 p refs
(Contract W-7405-ENG-68)
(PPB-180748; UCRL-18258) Avail: CFSTI CSCL 11B

Cation interdiffusion was investigated in single crystals of NiO, CaO, and MgO in the temperature range 1300C-1700C. The excess cation vacancies present in NiO in air cause diffusion to proceed more rapidly in NiO than in either CaO or MgO. This in turn causes the phase boundary between the diffusing crystals to move and the NiO grows at the expense of the other crystal. If the two crystals are of different crystallographic orientation, the orientation of the volume swept out will transform to that of the growing crystal. For NiO-CaO and NiO-MgO diffusion anneals in air, the diffusivity was found to be exponentially dependent on the Ni concentration. An explanation for this is presented. Author (USGRDR)

N69-22848# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerper- und Neutronenphysik.

HYDROGEN IN METALS AS AN EXAMPLE FOR A LATTICE GAS WITH PHASE TRANSITIONS: STATIC AND DYNAMIC CRITICAL PHENOMENA [WASSERSTOFF IN METALLEN ALS BEISDIEL FUER EIN GITTERGAS MIT PHASENUMWANDLUNGEN: STATISCHE UND DYNAMISCHE KRITISCHE PHAENOMENE]

G. Alefeld Nov. 1968 51 p refs In GERMAN; ENGLISH summary
(JUL-561-FN) Avail: CFSTI

Phase diagrams and solubility measurements for hydrogen interstitially dissolved in metals are studied. It is concluded, that in the space of the metal matrix the phase transition from the gaseous state to the liquid occurs, in complete analogy to free hydrogen. The critical point of the miscibility gap is identified with the critical point for the phase transition gas to liquid. From solubility measurements, diagrams for the equation of state of the lattice gas are derived. These show the characteristic features known for a real free gas including the critical point, and the two phase region bound by the coexistence curve. The diffusion constant of dissolved hydrogen exceeds the common value for solid state systems at room temperatures by a factor of 10, and is comparable with that in free liquids. Author

N69-22848# Office Nation d'Etudes et de Recherches Aerospatiales, Paris (France).

ON THE RELATION BETWEEN THE INTERCRYSTALLINE STRUCTURE AND THE CREEP BEHAVIOUR OF Λ-BRASS [ETUDE DE RELATIONS ENTRE LA STRUCTURE INTRACRISTALLINE ET LE COMPORTEMENT EN FLUAGE DANS LE LAITON Λ]

Hubert Damiani 1968 96 p refs In FRENCH; ENGLISH summary
(ONERA-NT-127) Avail: CFSTI

Using a very smooth anodic attack, and transmission electronic microscopy, this paper studies the influence of the initial intercrystalline structure of a polycrystalline brass on its creep behaviour around 400°C, and the evaluation of this sub-structure during creep. The tests show that: (1) the initial creep rate is higher when the density of the initial free dislocations is greater; the recrystallised metal presents an incubation period, a phenomenon which does not seem to have been observed to date on a polycrystalline metal; it is suggested that this incubation is due to the interaction between the solute atoms and the dislocations specific to the face centered cubic solid solutions; (2) whatever the initial state there appears, during the second stage, a cellular substructure which alters with time; the steady state creep rate decreases with the density of initial free dislocations. During a cold-working by traction at room temperature appear clusters of

pinnad down dislocations of which the strain fields hinder the dislocation displacement during the subsequent creep; during the annealing polygonization at 600°C after traction at room temperature appear regular polygonization networks, later, a lower creep stationary rate. Author

N69-22947# Kansas Univ., Lawrence.
POINT DEFECTS IN IONIC CRYSTALS Final Report
Robert J. Friauf 30 Sep. 1968 14 p refs
(Contract AT(11-1)-1197)
(COO-1197-37) Avail: CFSTI

Studies on diffusion of Ag in AgCl yielded quantitative data on collinear and noncollinear interstitialcy motion, and provided an absolute test for comparison of diffusion and ionic conductivity measurements. A new experimental technique of tracer diffusion in an electric field was used in studies of Na diffusion in NaCl. Studies on diffusion of Tl and Cl in TlCl confirmed diffusion by single vacancies with additional diffusion by either vacancy pairs or next nearest neighbor jumps. A method was devised for calculating correlation coefficients for the proposed new diffusion mechanisms in TlCl. Optical absorption experiments identified bands associated with Mg in LiF and with trapped dielectrons in alkaline ice. Photoconductivity measurements helped to substantiate recently proposed models for Z_2 and Z_3 centers in KCL:Sr. Author (NSA)

N69-22962 Technische Hochschule in Wien (Austria). Institut fuer Hochfrequenztechnik.
STUDIES ON SOLIDS WITH HIGH-FREQUENCY MEASURING TECHNIQUES [UNTERSUCHUNGEN AN FESTKOERPERN MIT MESSMETHODEN DER HOECHSTFREQUENZTECHNIK]
31 Dec. 1968 84 p refs In GERMAN
(HL-10) Avail: CFSTI

A simple method for calculating the high-frequency conductivity from the dc behavior of a sample was derived from the theory on high-frequency conductivity of single-valley semiconductors in the presence of a strong constant electrical field. In addition to conventional conductivity measurements, a new method was used for determining the impulse relaxation time from the microwave conductivity in case of a parallel constant and microwave field. The production of GaAs Gunn diodes is described. Helicon diagnostic was used for the study of moving high-field domains and stationary domains on the anodes and for examining the correlation between electroacoustic phenomena and the Larrabee microwave emission in InSb. In another separate study, the Manley-Rowe equations, the energy balance, and the gain band product are derived for parametric amplifiers with Josephson tunnel contacts. The design of an analog model for studying the behavior of Josephson contacts in switching circuits is described. Transl. by K.W.

N69-22988*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PUMPED HELIUM TESTS OF A 51-CENTIMETER BORE NIOBIUM-TIN MAGNET
Willard D. Coles, Gerald V. Brown, Erwin H. Meyn, and E. R. Schrader (RCA) Washington Apr. 1969 12 p refs
(NASA-TN-D-5158) Avail: CFSTI CSCL 20L

Performance data are presented for tests of 51-cm bore solenoids operated at temperatures below 2°K. The magnet coils are wound of vapor-deposited Nb_3Sn ribbon which was copper-clad for one of the magnets and silver-plated for the others. Coil protection was provided by cross-layer shorting strips which also provide very limited stabilization. Each coil was designed to produce a 4.0-T center field. Results obtained at the low temperature are compared with those obtained at 4.2°K. System description and charging characteristics are included in the discussion. Author

N69-23026# Dartmouth Coll., Hanover, N. H. Dept. of Physics.
COLOR CENTERS AND THE THERMOLUMINESCENCE PROCESS IN LiF:Mg
M. R. Mayhugh, R. W. Christy, and N. M. Johnson *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 294-301 (See N69-23005 11-06) refs
(Contract AT(30-1)-3474) Avail: CFSTI

A systematic study of radiation induced color centers in LiF:Mg was made at low dose for increased understanding of the thermoluminescence mechanism in this material. Important Mg-related optical absorption was observed from 310 to 380 nm. In particular, the main thermoluminescence dosimetry peak is associated with the centers which produce a 310 nm absorption band. The thermoluminescence mechanism in this glow peak and two related ones is shown to involve electrons which are thermally released from 310 and 250 nm optical bleaching experiments on thermoluminescence samples. Complexes involving Mg^{++} ions, cation vacancies, and anion vacancies are suggested as electron traps. Author

N69-23027# Naval Research Lab., Washington, D. C.
THERMOLUMINESCENCE PROCESSES AND COLOR CENTERS IN LiF:Mg
E. W. Claffey, C. C. Klick, and F. H. Attix *In* AEC 2D Intern. Conf. on Luminescence Dosimetry [1968] p 302-309 (See N69-23005 11-06) refs
(Contract AT(49-7)-1864)
Avail: CFSTI

Optical absorption measurements were made on a large single crystal of commercial LiF:Mg under conditions such that sensitization or supralinear responses appear in thermoluminescence. The sensitization process, consisting of a large pre-dose irradiation exposure followed by thermal bleaching at a moderate temperature, introduces a large number of F centers. The F center is proposed as the luminescence center; the sensitization process then consists of introducing a large number of luminescence centers into the material. At doses larger than 10^{-3}R, thermoluminescence response increases faster than the dose. Measurements on crystals, however, show both the Mg (hole-trap) bands and the F center band increasing linearly in this dose region. A model is proposed that qualitatively explains these phenomena. It proposes that F centers are formed along the track of an energetic electron and that holes are trapped by Mg ions near the track. Recombination is principally between centers in the same track at low doses, but includes F centers from previous tracks at high doses. The model appears to be able to explain sensitization, supralinear response, and previously observed quality dependences in thermoluminescence. Author

N69-23028# California Univ., Livermore. Lawrence Radiation Lab.
TLD SUPRALINEARITY AND OPTICAL ABSORPTION IN LiF CRYSTALS
R. M. Grant, Jr. and D. E. Jones *In* AEC 2d Intern. Conf. on Luminescence Dosimetry [1968] p 310-318 refs (See N69-23005 11-06)
Avail: CFSTI

An experiment is reported which was designed to measure both the radiation quality dependent thermoluminescence (TL) supralinearity and the simultaneous changes in two of the optical absorption bands (250 nm and 310 nm) of TLD-100 grade LiF. The samples were 1 cm cubes cleaved from a small portion of a large ingot. Optical measurements were made after each increment of exposure while TL measurements were made at the end of all irradiations. Exposure rates were chosen so the absorbed dose rates were similar for the two irradiation sources (40 keV effective x-rays and Co^{60} γ rays). In this way, the growth rates of the absorption bands and the TL could be quantitatively compared. The data show that the F bands (250 nm) grow at nearly the same

rate for both sources, whereas the 310-nm bands grow faster with Co^{60} γ-ray irradiation than with 40 keV effective x-ray irradiation. Changes are shown in the relative sensitivity which are strongly dependent upon dose normalization. Author

N69-23177# Oesterreichische Studiengesellschaft fuer Atomenergie G. m. b. H., Seibersdorf. Reaktorzentrum.
THERMAL-DIFFUSIVE SCATTERING OF X-RAYS ON BISMUTH SINGLE CRYSTALS [THERMISCH-DIFFUSE STREUUNG VON ROENTGENSTRAHLEN AN WISMUTEINKRISTALLEN]
H. Muschik and E. M. Hoerl 1968 13 p refs In GERMAN
Presented at the Tagung Der Oesterr. Physik. Ges., Graz, Sep. 1968 Submitted for Publication
(SGAE-M-24/1968) Avail: CFSTI

The ranges of high-intensity thermodiffusive scattering in the k space of reciprocal lattices were determined, and the temperature dependence of the scattering process was measured. The measurements were made with a Laue camera connected with a monochromator. The bismuth crystal was fixed in the desired orientation on a heated goniometer table. White-X-ray radiographs were used to orient the crystal. The intensity distribution of the thermal background was obtained by evaluating the Laue photograph after exposure of the film for approximately 100 hours. Transl. by K.W.

N69-23193# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.
ELECTRON PARAMAGNETIC RESONANCE OF CO-DOPED PBW04 Interim Technical Report
Mao-Chieh Chen Jan. 1969 95 p refs
(Contract DA-31-124-ARO(D)-372)
(AD-682018; AROD-5738.2-P) Avail: CFSTI CSCL 20/12

The electron paramagnetic resonance of Co-doped PbWO4 has been observed on a superheterodyne X-band microwave spectrometer at temperatures between 4 degrees K and 15 degrees K. Four groups of EPR spectra were found. These spectra could be mapped into each other by suitable transformations and, hence, were basically the same. The three Eulerian angles characterizing the principal coordinate system of one such group with respect to the crystal axis (c a a) system are 43.8 degrees, 28.0 degrees and -65.3 degrees. The orientations of the remaining three groups are obtained by successive 90 rotations about the c-axis. In its principal axis system, each spectrum was characterized by an effective spin S equal to 1/2 and a nuclear spin I equal to 7/2. From various evidence we conclude that the Co enters the lattice in a 2+ state and probably substitutes at a W site. Author (TAB)

N69-23325# Lockheed Missiles and Space Co., Palo Alto, Calif.
METHODS OF INVESTIGATING ELECTRONIC SURFACE STATES, CHAPTER 2
[1968] 23 p refs
Avail: CFSTI

Several methods are assessed for their efficacy in detecting electronic surface states by the charge on a semiconductor surface; this surface charge produces an electric field which intrinsically results in a number of surface-responsive phenomena. Methods of investigating and producing new data were developed by studying the factors which influence the degree of filling of the electronic surface states. These methods include: semiconductor surface electrical conductivity measurements, electron work function measurements, combination methods of measuring semiconductor conductivity, shielding the external electrical field by semiconductor surface charges, photoelectric and optical techniques condenser photo effect, photo emission from semiconductors, Ojet effect, and radio spectroscopy. M.G.J.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-22400# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
INVESTIGATION OF HIGH AND LOW TEMPERATURE RESISTANT EXPLOSIVE DEVICES
E. Eugene Kilmer 5 Nov. 1968 36 p refs
(NOLTR-68-135) Avail: CFSTI

This report covers additional work in the area of investigation of the performance of MDFs and FLSCs after high temperature exposure. MDFs and FLSCs loaded with RDX (93.5%) and RDX (99.5%) were exposed to elevated temperatures in an obturated system. Observations on the high temperature exposure of MDFs and FLSCs are discussed with recommendations for limits of exposure. The low temperature shock sensitivity of HNS-II/Teflon 90/10 mixture has been determined. Author (TAB)

N69-22558# IIT Research Inst., Chicago, Ill.
PHYSICAL NATURE OF PROPELLANT SENSITIVITY Summary Report, 1 Dec. 1967–30 Nov. 1968
Ted A. Erikson Dec. 1968 53 p refs
(Contract F44620-67-C-0036)
(AD-681529; IITRI-C6099-2; AFOSR-69-0180TR) Avail: CFSTI CSCL 21/9.1

A propellants sensitivity is the result of an intimate relation between a chemical reaction and a change in phase. Practically, slight additions of energy to an unstable system cause a complicated series of chemical reactions from which the role of vaporization is difficult to isolate. The several elements of liquid integrity are demonstrated in experiments where pure and inert isolated (in glass) liquid systems were placed in states of negative pressure, that is, hydrostatic tension. Physical interactions are apparent by disruption of this state and the effects of thermal and mechanical influence upon bubble nucleation, vaporization, condensation, and subsequent purity were qualitatively examined. These results were confirmed by recent literature. Localized superheating demolished glass equipment by liquid inertial effects, clearly demonstrating the principle that explosive responses can be physical, as well as chemical, in nature. Author (TAB)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-22408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL STRESSES IN GAS TURBINE NOZZLE BLADES UNDER TRANSIENT THERMAL CONDITIONS
R. I. Kuriat and Yu. D. Miroshnichenko Jun. 1968 14 p refs
Transl. into ENGLISH from Energomashinostr. (Moscow), v. 12, no. 10, 1966 p 30–32
(AD-681618; FTD-MT-24-157-68) Avail: CFSTI CSCL 21/5

Results are given of rough estimate of thermal stresses appearing in gas turbine nozzle blades (solid and hollow cooled) during tests under conditions close to real. Calculations were produced on the BESM-2M computer. Deformation of blade elements was assumed elastic. Author (TAB)

N69-22795*# Rocketdyne, Canoga Park, Calif.
STUDY OF DUAL-CHANNEL INFRARED SPECTRORADIOMETER SYSTEMS, PHASE 2 Interim Report
W. F. Herget 30 Dec. 1968 29 p refs
(Contract NAS8-21144)
(NASA-CR-98376; R-7733) Avail: CFSTI CSCL 21H

A dual-channel spectroradiometer system, installed at the high altitude facility, allows zone radiometry measurements in absorption and emission to be made on large rocket engine exhausts. From these measurements, the temperature and partial pressure distributions may be calculated for various species in the exhaust. Data were taken on five tests, one each with F_2/H_2, $FLOX/CH_4$, $FLOX/B_2H_6$, OF_2/CH_4, and OF_2/B_2H_6. The results of these tests are presented. Author

N69-22928# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF DYNAMIC ROCKET THRUST MEASUREMENT TECHNIQUES Final Report, Jun. 1966–Aug. 1967
F. L. Crosswy and H. T. Kalb AEDC Nov. 1967 92 p refs
(Contract AF 40 (600)-1200)
(AD-823181; AEDC-TR-67-202) Avail: CFSTI CSCL 14/2

The dynamic rocket thrust measurement is set forth as a part of the overall ground test problem. Dynamic thrust data obtained with conventional thrust measurement techniques can be distorted because of the transient response of the thrust stand-rocket engine mechanical structure. Distortionless dynamic thrust measurement is shown to be possible if the transfer function of the measurement system satisfies certain criteria. Three independent techniques satisfying the distortionless measurement criteria were investigated both analytically and experimentally, and the results are presented and discussed. The development and use of several dynamic force calibrators are also discussed. Author (TAB)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-22187*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MAGNETIC FIELD OF THE MAGNETOSPHERE AND TAIL
D. H. Fairfield Apr. 1969 47 p refs Presented at the NATO Advan. Study Inst. on Production and Maintenance of the Polar Ionosphere, Tromsø, Norway Submitted for publication
(NASA-TM-X-63808; X-616-69-124) Avail: CFSTI CSCL 04A

Earth orbiting spacecraft have made extensive measurements of the solar wind-compressed magnetic field in the sunward magnetosphere and the extended magnetic field of the geomagnetic tail. Analysis of the measurements indicate that in an average magnetosphere, field lines crossing the earth above 78°+3° and 69°+2° geomagnetic latitude in the noon and midnight meridians respectively are extended into the geomagnetic tail. Field lines in the northern and southern hemispheres of the tail are generally oriented parallel or anti-parallel to the earth sun line with two regions being separated by a neutral sheet or current sheet less than 1 R_E thick. The average field magnitude is 16γ at 20 R_E and 7γ at 80 R_E except in a region within about 6 R_E of the neutral sheet where the field is depressed by a factor of 2. The observation of tail-like fields almost 1000 R_E behind the earth by the Pioneer 7 spacecraft sets a lower limit on the radial extent of tail associated effects. Departures from the average magnetosphere field configuration occur at the times of magnetic storms and bay events. Author

N69-22309*# Techtran Corp., Glen Burnie, Md.
MEASUREMENT OF POLARIZATION OF LOW-INTENSITY X-RAYS [K VOPROSY OB IZMERENII POLYARIZATSII RENTGENOVSKIKH LUCHEY SLABOY INTENSIVNOSTI]
A. A. Sanin et al Washington NASA Apr. 1969 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. 3, Fiz. Astron. (Moscow), no. 4, 1967 p 105–108
(Contract NASw-1695)
(NASA-TT-F-12195) Avail: CFSTI CSCL 20H

A method for measuring the polarization of low-intensity X-rays is described. The method is proposed in connection with application in space aboard satellites, where the usual measurement methods cannot be used due to size and weight. It is assumed that X-ray quanta interact with the substance of measurement device and that the photoeffect and Thomsin scattering are the only two possible processes which can occur for energies of the order of units and tens of KeV. The experimental geometry is described. Author

N69-22389*# Volt Information Sciences, Inc., Washington, D. C.
FLUX OF LOW ENERGY PROTONS IN THE NEIGHBORHOOD OF THE MOON ON 13 DECEMBER 1966 [POTOK PROTONOV MALYKH ENERGIY V OKRESNOSTI LUNY 13 DEKABRYA 1966 G]
N. L. Grigorov et al Greenbelt, Md. NASA Goddard Space Flight Center 1 Apr. 1969 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 137–142
(Contract NAS5-12487)
(NASA-CR-100521; ST-PF-LPS-10821) Avail: CFSTI CSCL 20H

Luna-12 measurements of low energy protons are investigated. The composition, temporal variation and angular distribution of emission fluxes point to the fact that the observed burst of protons is linked with the crossing by the satellite of a region of magnetized plasma, populated by low energy protons (0.5 – 10 Mev). The character of the proton flux angular distribution rules out the assumption about radiation captured by a magnetic trap moving with the flux of solar plasma. It is noted that the given event has a series of common singularities with the earlier investigated bursts of low energy protons, coinciding with the commencement of the Forbush drop. Author

N69-22487# Osservatorio Astrofisico di Arcetri, Florence (Italy).
VARIATION OF THE CALIBRATION CURVE FROM LABORATORY TO FLIGHT CONDITIONS IN THE SOLRAD LYMAN-ALPHA ION CHAMBER
R. Barletti, B. Monsignori Fossi, G. Poletto, and G. L. Tagliaferri *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 213–217 (See N69-22476 11-30) refs
Avail: CFSTI

During an investigation of solar Lyman-alpha variations, a bias was discovered in the response curve of the SOLRAD 8, 1080–1350 Å ion chamber. A simple method used to derive the new calibration curve is described and the deduced absolute Lyman-alpha fluxes are given. Author (ESRO)

N69-22498# Harvard Coll. Observatory, Cambridge, Mass.
CALIBRATION OF ROCKET AND SATELLITE SPECTROMETERS IN THE WAVELENGTH RANGE 1400–2200 Å
W. H. Parkinson and E. M. Reeves *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 219–229 refs (See N69-22476 11-30)
Avail: CFSTI

The accurate determination of the photometric response of spectrometers is necessary for the interpretation of the atomic and molecular contributions to solar opacity and the structure of the temperature minimum. A photoelectric scanning rocket spectrometer with high spatial resolution has been developed to record the solar spectrum. Later versions will perform centre-to-limb scans with 7 sec resolution in selected wavelength intervals. Absolute photometric calibration has been accomplished with reference to a thermopile as standard. Calibration techniques such as beam homogeneity, uniformity of photocathode response, detector linearity and mirror reflectance and stability are discussed.
Author (ESRO)

N69-22499# Harvard Coll. Observatory, Cambridge, Mass.
SATELLITE INSTRUMENTS WITH 300 TO 1400 Å PHOTOMETRIC CALIBRATION
Martin C. Huber, W. H. Parkinson, and E. M. Reeves *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 231–244 refs (See N69-22476 11-30)
Avail: CFSTI

The Orbiting Solar Observatory series of satellites has provided the opportunity for prolonged observations of the EUV solar spectrum. The objective of the Harvard programme has been to obtain spectroheliograms with 0.5–1 arc min spatial resolution from different heights in the solar atmosphere. Wavelength and photometric calibrations have been made by using a series of emission lines from a hollow cathode lamp and the measured absolute photoelectric yield of tungsten. The effects of gratings in series, photocathode uniformity, detector stability, deterioration of reflectance, and efficiency stability in storage are discussed.
Author (ESRO)

N69-22500# United Kingdom Atomic Energy Authority, Culham (England)
INTENSITY CALIBRATION OF GRAZING INCIDENCE SPECTROGRAPHS IN THE SOFT X-RAY REGIONS
B. B. Jones and F. F. Freeman *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 245–252 (See N69-22476 11-30) refs
Avail: CFSTI

A simple method is outlined for the intensity calibration of spectrographs in the approximate wavelength range 10 Å–100 Å. The calibration is made using a proportional counter as a detector standard, with a soft X-ray tube as the source of radiation. A characteristic curve for the photographic emulsion is constructed in absolute units using a type of pinhole camera together with the counter and X-ray source. An overall transmission constant for the spectrograph is then obtained which can be used over the full range of photographic densities below the saturation level. The method also allows the grating transmission factor to be determined.
Author (ESRO)

N69-22774*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
PARTICLE MOTIONS IN A MAGNETIC FIELD
Martin Braun (Ph.D. Thesis) Mar. 1969 87 p refs
(GRANTS NGL-40-002-015; AF-AFOSR-693-67)
(NASA-CR-100611; CDS-TR-69-1) Avail: CFSTI CSCL 04A

A theory of almost periodic motions is developed as related to the Stormer problem, a mathematical formulation of the motion of a charged particle in the geomagnetic field. By these calculations, it is possible to exhibit the trapping of charged particles as observed in the Van Allen belt. As an additional feature, it is shown that the theory can easily be generalized to any rotationally symmetric mirror field.
A.C.R.

N69-22887*# Volt Information Sciences, Inc., Washington, D. C.
INTERACTION OF COSMIC PROTONS WITH INTERPLANETARY PLASMA
Yu. M. Nikolayev Greenbelt, Md. NASA Goddard Space Flight Center 4 Mar. 1969 27 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. 3, Fiz. Astron. (Moscow), no. 1, 1969 p 113–116
(Contract NAS5-12487)
NASA-CR-100530; ST-CR-IP-10814) Avail: CFSTI CSCL 20H

Considerations are given for the energy losses of a nonrelativistic proton beam to the excitation of longitudinal electrostatic oscillations of interplanetary plasma. Linear approximations and distribution functions are derived to solve for the energy losses.
B.G.D.

N69-22968*# Naval Aerospace Medical Inst., Pensacola, Fla.
COMPARATIVE EVALUATION OF THE RADIATION ENVIRONMENT IN THE BIOSPHERE AND IN SPACE
Hermann J. Schaefer 13 Dec. 1968 20 p refs
(NASA Order R-75)
(NASA-CR-100647; NAMI-1054) Avail: CFSTI CSCL 04A

The natural level of background radiation in the biosphere ranges from a lowest value of 6 microrem/hr over the ocean to values more than 300 times higher that are found in small inhabited areas in Brazil and India. These highest radiation levels in the biosphere overlap the lowest in space as long as only regions outside the radiation belt and conditions of a quiet sun are considered. Since shelters for solar proton storms on the moon or planets could be built, utilizing indigenous rock, man's long-term survival in space appears to be assured as far as ionizing radiation is concerned. The inconspicuous chronic damage, such as shortening of the life span, that would result from galactic radiation exposure in space is difficult to assess quantitatively. Extrapolating data on radiation-induced life shortening with gamma rays and neutrons for the mouse, one arrives at a figure of 25 percent for the life-shortening effect of galactic radiation exposure in space. As far as acute effects from trapped or flare-produced protons are concerned, the most acute problem operationally is the treatment and alleviation of discomfort from skin erythema, and possibly more severe skin damage, resulting from medium-high doses which would leave more deeply seated tissues and organs essentially intact because of the much lower depth doses of these peculiar radiations.
Author

N69-23221# Lockheed Missiles and Space Co., Palo Alto, Calif.
MEASUREMENT OF THE RADIATION EFFECTS OF THE AMERICAN HIGH ALTITUDE THERMONUCLEAR EXPLOSION SEA STAR ON THE COSMOS-6
Iu. G. Shafer et al 1968 14 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 877–886
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results of measurements on the Cosmos 6 of the effect of the American thermonuclear explosion of July 9, 1962, are analyzed. The deductions obtained earlier from Cosmos 5 and Cosmos 3 data, that radioactive products of the explosion are adsorbed on the satellite surface during its motion through the

contaminated upper atmosphere, are confirmed. Estimates are made of the velocity of longitudinal drift of the energetic fragments adsorbed on the satellite housing in the first hour after the explosion. From these estimates, there is obtained a mean velocity of inertial escape of the plasma cloud particles. Within the limits of error, this estimate agrees with the velocity obtained from experimental measurements on the time of appearance of fission products in the conjugate domain. It is shown that some fraction of the fragments remained for a long time (on the order of several weeks) at altitudes near the F region maximum of the ionosphere, and the mean fragment concentration along the orbit at the satellite flight altitudes (250 to 350 km) was 0.1 – 0.01 fission/cm^3 in this period. Author

N69-23239# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA. CHACALTAYA, BOLIVIA–1: OCTOBER 1966–DECEMBER 1967 [MONITOR DE NEUTRONES NM-64. CHACALTAYA, BOLIVIA–1: OCTUBRE 1966–DICIEMBRE 1967]
H. S. Ahluwalia, G. R. Mejia, and J. F. Steljes Aug 1968 69 p refs In ENGLISH and SPANISH
(AECL-3162) Avail: CFSTI; Atomic Energy of Can. Ltd., Chalk River: $1.50

Uncorrected and barometer corrected results from the cosmic ray station at Chacaltaya, Bolivia, are given in tabular form from October 1966 to December 1967. Normalized graphs of the neutron monitor and of the barometric pressure are also given. Author (NSA)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-21957 Colorado Univ., Boulder.
THE STRUCTURE, DYNAMICS, AND EVOLUTION OF SOLAR CORONAL STREAMERS
John David Bohlin (Ph.D. Thesis) 1968 237 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-14230

Twelve coronal streamers were identified using the 1965 solar eclipse and three stratospheric balloon flights of an externally-occulted coronograph (CORONASCOPE II; one flight in 1964, the other two 4 and 32 days after the eclipse). These streamers were located on the disk of the Sun using the nearly daily observations of the inner K-corono ($r < 1.75$ solar radii $R_\odot$) from a ground-based coronagraph (K-coronameter). The morphology and evolution of streamers were then determined from cross correlation of coronal and solar activity data. The spatial location of coronal structure was related to interplanetary and geomagnetic phenomena through the Sun–Earth transit time of solar wind plasma. Integration of representative velocity distributions gave transit times of 4-1/2 ± 1/2 days when acceleration time close to the Sun was taken into account. This time interval has precedence from cross correlation of solar and interplanetary magnetic fields as well. Dissert. Abstr.

N69-21972 Arizona Univ., Tucson.
MICROTURBULENCE IN MAIN SEQUENCE STARS
Frederic Henry Chaffee, Jr. (Ph.D. Thesis) 1968 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-14513

High dispersion spectra have been obtained for 23 main sequence stars in the spectral range from A0 to G0. Spectra were observed in the green for 17 of these stars at a dispersion of 17.8A/mm, and in the blue for 8 of the stars at a dispersion of 8.9 A/mm. Microturbulent velocities have been determined for each of these stars from a curve of growth analysis of approximately 90 Fe I lines in each stellar spectrum. The variation of microturbulence with temperature (as indicated by the b-y photometric index) is such that the microturbulent velocity has two maxima—one at spectral class A8 and one at G0. In addition, there are two minima—one in the early A stars and the other in the middle F stars. Dissert. Abstr.

N69-21982 Colorado Univ., Boulder, Colo.
THE MONOCHROMATIC SUN IN THE EXTREME ULTRAVIOLET
William Jarvis Boardman (Ph.D. Thesis) 1968 204 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-14369

Spectroheliograms of the sun taken during an Aerobee rocket flight made on April 28, 1966 by the U.S. Naval Research Laboratory give a resolution of the solar disk of 10" of arc in the spectral region 170–630A. Although a considerable amount of overlap of the solar images in the various emission lines is evident, active regions are clearly distinguishable particularly in the lines of Fe IX to XIV, Mg IX, and Si XII. The degree of localization of emission shows a definite increase with increasing temperatures characteristic of the ions responsible for the emission. Two features near the east limb of the sun were sufficiently free from contamination by background continuum and overlapping by other features to permit measurements of their maximum brightnesses in the various lines. For one of these two features, the associated chromospheric emission was just barely occulted by the solar limb, thus the observed emission was purely coronal. Dissert. Abstr.

N69-22021 Yeshiva Univ., New York.
PULSATIONS OF MASSIVE STARS
Norman R. Simon (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-10987

Models are constructed of massive stars in the core helium burning phase of post main sequence evolution. Tests made for stability against nuclear energized pulsations show these models to be extremely stable as a result of the increasing central condensation which accompanies evolution away from the main sequence. Comparison of pulsation theory with observations of blue supergiants in the Magellanic Clouds yields the following consistent set: (1) a main sequence stability limit of $\simeq 60\ M_\odot$; (2) a zero age chemical composition $X_0 \simeq .75$, $Z_0 \simeq .02 - .03$. A sharp cutoff of observed stars at $\simeq 60\ M_\odot$ indicates probably disruptive instability for main sequence stars exceeding this mass. A second group of models are built with helium burning cores, hydrogen poor envelopes and a thin hydrogen shell source which may or may not be ignited. Dissert. Abstr.

N69-22107 Colorado Univ., Boulder.
ASTRONOMICAL OBSERVATIONS AT LOW RADIO FREQUENCIES
Thomas Arvid Clark (Ph.D. Thesis) 1968 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-12394

This thesis presents the results of a series of low frequency radio-astronomical observations made during the period of the most recent minimum of solar activity. The bulk of these observations were made using the large 10 MHz telescope. Astronomical observations at frequencies below about 30 MHz are severely limited by the presence of the terrestrial ionosphere. The observations

presented in this thesis were made during the years 1963–1966 during solar minimum. The telescope used for the observations and the nature of the limitations imposed by the ionosphere are discussed at some length. Observations in four general areas are presented: (1) Observations of discrete radio sources, (2) observations of the radio emission from our galaxy, (3) observations of the sporadic radio emission from Jupiter and (4) observations of solar radio emission. Dissert. Abstr.

N69-22113*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PHYSICAL PROPERTIES OF THE RADIO-EMITTING REGION IN SCO X-1

Guenter R. Riegler (Md. Univ., College Park), and Reuven Ramaty Mar. 1969 14 p refs

(Grant NGL-21-002-033)

(NASA-TM-X-63507; X-611-69-123) Avail: CFSTI CSCL 03B

On the basis of recent observations it was deduced that the radio emission from Sco X-1 is synchrotron radiation of relativistic electrons in an extended low-density region surrounding a denser core which produces the X-ray and optical continua. The linear dimensions of the radio-emitting region are larger than 10^{12} cm, the ambient density is less than 10^{9} cm^{-3} and the radiation could typically be produced by electrons of about 15 MeV in a magnetic field of a few gauss. Author (BGD)

N69-22158*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THERMAL AND TIDAL EFFECT ON THE LIBRATION OF MERCURY

Han-Shou Liu Mar. 1969 10 p refs

(NASA-TM-X-63509; X-643-69-127) Avail: CFSTI CSCL 03B

It is shown that the influences of the thermal and tidal effects on Mercury's libration are in an equilibrium condition with the periods of rotation and revolution of Mercury locked in the 3:2 resonant state. Author

N69-22226*# National Aerounautics and Space Administration, Washington, D. C.

SIXTH ANNUAL MEETING OF THE WORKING GROUP ON EXTRATERRESTRIAL RESOURCES

1968 247 p refs Meeting held at Brooks AFB, Tex., 19–21 Feb. 1968

(NASA-SP-177) Avail: CFSTI CSCL 22A

In the conference papers presented, attention was focused on various aspects of environment and resources; mining and processing; biotechnology and human factors; facility design, construction, and operation; and logistic requirements. For individual titles, see N69-22227 through N69-22246.

N69-22227*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE LUNAR ENVIRONMENT: A REEVALUATION WITH RESPECT TO LUNAR BASE OPERATIONS

Paul D. Lowman, Jr. *In its* 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 5–9 refs (See N69-22226 11-30)

Avail: CFSTI CSCL 03B

The following aspects of the lunar environment which bear on the feasibility of long manned lunar surface missions and lunar bases are reviewed: gravity and magnetic fields, radiation, surface temperatures, atmosphere, meteoroid and secondary ejecta flux, nature of the terrain and surface materials, and concepts of lunar geology. Virtually all new information on these subjects is either favorable or, if unfavorable, predictable. It is concluded that, with respect to the lunar environment, lunar staytimes of 3 months could be scheduled at this time; 1-year missions appear feasible, and there are no obvious factors definitely preventing establishment of a permanent lunar base. More information is needed, however, on meteoroid flux, trafficability of the highlands, nature of lunar water deposits, geological hazards, hazards connected with lunar transient phenomena, and long-term biological effects of the lunar environment. Author

N69-22229*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.

USES OF TEMPORAL DATA IN REMOTE SENSING

J. D. Halajian and H. B. Hallock *In* NASA, Washington. 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 29–57 refs (See N69-22226 11-30)

Avail: CFSTI CSCL 03B

The potential of complementing pictorial data with the study of the time behavior of quantified radiation from a target element is explored. Temporal analysis of the quantity, polarization, and spectral distribution of the electromagnetic flux from each element during a transient cycle promises information beyond the resolution of the viewing system. Laboratory analogs and theoretical models are used to illustrate the way that lunar photometric, polarimetric, and radiometric data can be correlated with roughness, porosity, bearing strength, internal heat sources, etc. Surveyor data are used in order to verify the correlations and to resolve some ambiguities. It is shown that earth-based, high resolution observations of the diurnal behavior of the lunar surface at optical and infrared wavelengths could supplement Orbiter photographs and lead to the discovery of suitable landing sites and/or prime targets of exploration. The importance of prereconnaissance diagnostic research and postreconnaissance ground truth measurements as integral parts of a remote sensing strategy is stressed. Author

N69-22230*# Douglas Aircraft Co., Inc., Santa Monica, Calif.

SILICATE LUMINESCENCE AND REMOTE COMPOSITIONAL MAPPING

Norman N. Greenman and W. Bryan Milton *In* NASA, Washington. 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 55–63 refs (See N69-22226 11-30)

Avail: CFSTI CSCL 03B

Exploration for resources on the Moon will require, as it does on Earth, geologic maps of large areas of the surface. These can best be provided by remote sensing techniques from lunar orbiters. Almost two decades ago, when Link proposed that luminescence exists on the Moon, the possibility arose that this property could be the basis for such a technique, both for mapping the country rocks and for localizing the more rare mineralized zones. To evaluate this possibility, luminescence intensities of the common igneous rock forming minerals (to represent likely lunar country rock constituents) were measured with proton, electron, and X-ray excitation. The feldspars showed the highest intensities, and quartz, the next highest; intensities of the ferromagnesian minerals (mica, amphibole, pyroxene, and olivine) were very low, for the most part. This order of intensity was the same with all three excitation types. These results indicate that lunar acidic, basic, and ultrabasic rocks could be distinguished from one another on the basis of luminescence intensity. To represent possible lunar resource materials, volcanic, hydrothermal, and pneumatolytic minerals that may exist on the Moon, many of which contain water or OH groups in the lattice, will be measured in continuation studies now in progress. Author

N69-22231*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.

BUREAU OF MINES RESEARCH ON LUNAR RESOURCE UTILIZATION

Thomas C. Atchison and Clifford W. Schultz *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 65–74 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

The Bureau of Mines is cooperating with NASA to provide through a program of multidisciplinary research the basic scientific and engineering knowledge that will be needed to utilize extraterrestrial mineral resources for support of future space missions. The concept, scope, and present status of the Bureau's program are described. Author

N69-22232*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
SIMULATED LUNAR ROCKS
David E. Fogelson *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 75–95 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

The selection of rock materials is described for use by the Bureau of Mines in its extraterrestrial resources utilization studies which are designed to simulate the range of materials likely to be found on the Moon. It includes preliminary results of the measurement of the engineering properties of these materials. Author

N69-22233*# Bureau of Mines, Minneapolis, Minn. Twin Cities Metallurgy Research Center.
ORE DEPOSITS IN VOLCANIC ROCKS ON EARTH WITH LUNAR EXTRAPOLATION
Rolland L. Blake *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 97–106 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

A literature search was made on the origin of ore despoits in volcanic rocks on Earth. The close association between mineralization of the rocks in a region and the later stages of volcanism is well established. Also recognized is the prominent role of magmatic solutions composed mostly of juvenile water, but frequently supplemented with ground water, in the formation of mineral deposits by such processes as hydrothermal deposition and sublimation. Ten ore-forming processes were recognized, and eight of these form ore deposits in Earth volcanic rocks. Effects of the inferred lunar environment on processes forming ore deposits were also studied. Mineral deposits thought to exist in volcanic rocks on the Moon, in order of decreasing amount and likelihood, are those formed by the following six processes: Hydrothermal deposition, sublimation, combined eruption and exhalation, volcanic eruption, and, rarely, contact metasomatism and evaporation. The Moon is viewed as a still-dynamic body with some volcanism likely. Author

N69-22234*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
LUNAR DRILLING
James Paone and R. L. Schmidt *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 107–117 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

Problems are reviewed related to lunar drilling, data from Bureau drilling tests for lunar applications, and possible methods for predicting drillability of lunar materials from their engineering properties. Author

N69-22235*# General Dynamics/Fort Worth, Tex. Applied Research Lab.
LUNAR EXPLORATION FOR WATER DEPOSITS BY ELECTRICAL METHODS
Garry C. Henderson *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 119–125 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

Several electrical techniques employed in terrestrial exploration geophysics appear to show considerable promise for lunar surface applications, particularly in the search for water in the upper 100 meters of the surface. All of these methods rely primarily on the degree and extent of contrasts in the electrical properties of materials which lend themselves quantitatively to the interpretation process. The choice of scientific methods depends largely on the properties suspected to exist; the choice of operational methods influences the choice of scientific methods by limitations imposed by mission constraints. The selection of frequency (or frequency spectrum) in orbital or surface electromagnetic methods requires considerably different analyses than do the LF–DC (low frequency-direct current) resistivity techniques. Since there may be subsurface water as well as ice in some cases, the various kinds of ice, impurities (such as minerals, debris, and chemical contaminants), and multiphase systems and the effects on the conductivities of these water deposits are investigated primarily from the familiar resistivity viewpoint. Author

N69-22236*# Pennsylvania State Univ., University Park. Materials Research Lab.
DEVELOPMENTS IN QUANTITATIVE LUMINESCENCE TECHNIQUES
Raymond T. Greer, Vladimir Vand, Jon N. Weber, and Eugene W. White *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 127–132 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

In conjunction with the use of luminescence for the identification of lunar materials, a basic laboratory study has demonstrated the feasibility of obtaining useful correlations of mineral luminescent phenomena. Two monochromator–photomultiplier attachments to an electron microprobe were developed which permit the study of cathodoluminescence phenomena on a micron scale. The attachments extend the analytical capabilities of the instrument and facilitate: (1) recording of luminescence spectra, (2) obtaining the distribution of luminescent phases in microspecimens and bulk specimens, (3) evaluating and recording the relationships between fluorescence patterns and conventional X-ray representation of an area scan, (4) studying radiation influence on fluorescence decay, and (5) relating luminescence intensity to composition within a phase. This information provides a basis more reasonable than that formerly used for interpreting recent observations of lunar luminescence. Author

N69-22237*# Air Force Systems Command, Brooks AFB, Tex. Aerospace Medical Div.
UNORTHODOXIES AND CONTROVERSIES IN PLANETARY AND SPACE SCIENCE
Hubertus Strughold *In* NASA. Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 133–137 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

The gravitational decrease theory of Dirac is considered as an explanation for continental drift, faults, and volcanic eruptions on Earth. The phenomenon coupled with Mariner 4 data, is also examined with a view of explaining the frozen ocean theory of Mars. The existence of life on Mars was interpreted from past scientific observations. Controversial points concerning human physiology in space flight to Mars are discussed. B.P.

N69-22239*# National Aeronautics and Space Administration, Washington, D. C.
A PLANNING LOGIC FOR EXPLORATION AND UTILIZATION OF THE MOON
Rodney W. Johnson *In its* 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 157–171 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 22A

A methodology is presented for the design of a lunar exploration program. The logic is based upon (1) the recognition of the scientific objectives of lunar exploration as presently identified and (2) the critical and variable staytime requirements for lunar exploration missions. Systems ranging from orbital space flights, limited surface staytime exploration modes, and extended mobility missions to temporary stations and bases are included. The technique is based upon the assumption that, although the program planner cannot quantify either the scientific objectives or the output of a lunar exploration program it is nonetheless possible to employ quasianalytical techniques to derive semiclosed-form solutions to a mathematical model of a lunar exploration program. This is done by breaking down the scientific objectives and total scientific product of a lunar exploration program into percentages assigned to various exploration systems such as orbital, mobile, and fixed-base systems. Each system is designed to produce a given, assigned output of scientific product for each of the missions making up the flight program. In this manner a payload requirement (weight, volume, or power) can be developed for each mission within each system, and the experiment (and, hence, instrument) requirements can be identified as a function of the scientific questions requiring answers during the exploration program. Author

N69-22241*# Martin Co., Denver Colo.
INTEGRATION OF EXPECTED EXTRATERRESTRIAL RESOURCES INTO THE DESIGN OF SPACE TRANSPORTATION SYSTEMS
Robert S. Novosad *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 193–207 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

An evaluation of the benefits derived from the utilization of lunar materials as propellants for space systems is based on a logistics study. Various methods and opportunities to supply the materials required by a space program at various locations in space are examined. These include a number of different propellants with several sources and manufacturing processes as well as modes of delivery. The requirements are resolved into launch requirements from Earth and are used as a basis for comparing the alternatives that may be available. The results of previous mission analyses are integrated with logistics studies. Author

N69-22242*# General Electric Co., King of Prussia, Pa.
CISLUNAR (OR EARTH) SWINGBY FOR INTERPLANETARY MISSIONS
Samuel P. Altman *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 209–217 refs (See N69-22226 11-30)
Avail: CFSTI CSCL 22C

Cislunar swingby is the basic trajectory profile which initiates heliocentric flight from the earth–moon system by inception from cislunar space so that the spacecraft swings close by earth prior to injection into its interplanetary orbit. The energetics of this earth swingby are compared by means of parametric curves for the four alternative options of flight inception from a highly eccentric elliptic orbit about earth, the cislunar libration point L_1, a lunar orbit, or the lunar surface. It is shown that, for a given payload, the fuel mass expenditure for perigee departure from a highly eccentric orbit about earth is almost one-half that required for launching directly from the cislunar libration point. A comparison of the energetics for cislunar swingby (from lunar orbit), direct transfer, and planetary swingby (from low, circular, terrestrial orbits) shows that cislunar swingby alone offers fuel savings of about 50 percent over the other two profiles. In this comparison, only a outbound leg of heliocentric flight was considered. Additional savings could be realized by the combined use of cislunar and extraterrestrial planetary swingby profiles for a complete interplanetary flight. Author

N69-22243*# Air Force Missile Development Center, Holloman AFB, N. Mex.
IMPORTANCE OF THE USE OF EXTRATERRESTRIAL RESOURCES TO THE ECONOMY OF SPACE FLIGHT BEYOND NEAR-EARTH ORBIT
Ernst A. Steinhoff *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 219–233 (See N69-22226 11-30)
Avail: CFSTI CSCL 03B

Various possibilities and factors are considered which could involve, or result in, increased economy of space flight and the promotion of commercial ventures making industrial use of extraterrestrial resources: the lunar presence of water, minerals, and indigenous fuel sources for space transportation. It was concluded that a partly reusable transportation system which should include landing at and establishment of a lunar orbital terminal as well as a surface terminal can be considered well within the realm of possibilities of current technology and planned vehicles. A program to study the adaptability of the subsystems of all current space-launch and spacecraft systems from the aspect of their usefulness as reusable components of a new system is proposed. B. P.

N69-22245*# General Electric Co., Philadelphia, Pa.
UNDERWATER SIMULATION OF A LUNAR-SURFACE TRAVERSE
Marvin F. Clarke *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 253–262 (See N69-22226 11-30)
Avail: CFSTI CSCL 22A

As a supplement to the basic analytical approach toward determining the problems which man will encounter when he makes this first lunar walk, underwater simulation techniques were developed to provide insight into some of the specific problems to be expected. The underwater simulation techniques are based upon the crew performance of simulated mission tasks in a partial gravity or zero gravity condition when a specially designed backpack is used to provide life support and space suit pressurization and to maintain constant volume displacement of the underwater subject. The backpack also provides recorded measurements of key biophysical parameters. A simulated lunar traverse was made over an 80-foot course on the bottom of the bay at the Underwater Test Facility. Two different subjects in pressurized space suits in a simulated 1/6-gravity condition were used. Both subjects demonstrated their inability to walk purposefully under these conditions. The addition of a walking staff as a mobility aid made traverse of the simulated lunar terrain possible though still difficult. Author

N69-22246*# United Aircraft Corp., Windsor Locks, Conn.
MAN AS A RESOURCE ON THE MOON
Edwin G. Vail *In* NASA, Washington 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 263–273 (See N69-22226 11-30)
Avail: CFSTI CSCL 22A

Man is viewed as the primary integrator performing those functions for which there is no substitute. These integrator functions fall under the interpretation, judgment, and decisionmaking required

to keep a closed loop between man and equipment. This discussion is predicated upon the assumption that the initial Apollo missions have completed the preliminary exploration and geological survey of parts of the lunar surface and have identified a good site for a permanent base installation for exploiting extraterrestrial resources. The timespan for the activities described may begin in 1975 to 1978 and extend over a period of 10 years. This hypothetical base will be used to describe the role of man as a resource and to highlight his areas of activity. Author

N69-22247*# Volt Information Sciences, Inc., Washington, D. C.
RESULTS OF RADAR LOCATION OF PLANETS
O. N. Rzhiga Greenbelt, Md. NASA. Goddard Space Flight Center 28 Mar. 1969 16 p refs Transl. into ENGLISH from Kosmich. Issled (Moscow), v. 7, no. 1, 1969 p 84–91
(Contract NAS5-12487)
(ST-LPS-RA-10817) Avail: CFSTI CSCL 03B

A new method of radar observation enabled the accumulation of important data on the motion and the nature of planets. From the point of view of astronautics, the basic result of radar location of planets was the refinement of the astronomical unit, which, according to the measurements conducted in the USSR and agreeing with measurements of the USA and England, is equal to 149,598,000 ± 130 km. With the aid of radar location, errors were revealed in the existing theory of planet motion. Another important result was the determination of rotation periods of planets. Radar location permitted the discovery that Venus has a reverse rotation with a period of 243 days and that the rotation period of Mercury is 59 days (in the right direction). The radius of the hard Venus surface was also determined. Author

N69-22253*# Volt Information Services, Inc., Washington, D. C.
ON THE REDUCTION OF OBSERVATIONS WHEN USING A RADIOINTERFEROMETER WITH A LARGE BASE [O REDUKTSII NABLYUDENIY RADIOINTERFEROMETROM S BOL'SHOY BAZOY]
V. A. Alekseyev et al Greenbelt, Md. NASA. Goddard Space Flight Center 24 Feb. 1969 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 12, no. 1, 1968 p 139–141
(Contract NAS5-12487)
(NASA-CR-100544; ST-RA-RC-10809) Avail: CFSTI CSCL 03B

This note discusses the use of radiointerferometric systems for the study of angular dimensions and structures of various radio emission sources. The study is based on a proper assignment of antennas' and source's mutual position. Author

N69-22256*# Volt Information Sciences, Inc., Washington, D. C.
QUASI-PERIODICAL VARIATIONS OF SUN'S RADIOEMISSION IN THE 3.3 cm WAVELENGTH
M. S. Durasova et al Greenbelt, Md. NASA. Goddard Space Flight Center 17 Feb. 1969 refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Radiofiz. (Gor'kiy), v. 11, no. 12 p 1782–1790
(Contract NAS5-12487)
(NASA-CR-100542; ST-SP-RA-10806) Avail: CFSTI CSCL 03B

The results are presented of experimental study of fluctuations of Sun's radioemission flux. The correlation functions and registration spectra related to "quiet" and "active" Sun are investigated. Quasi-periodical variations of the flux with periods of about ≈250 and ≈700 sec are discovered. The intensity variations in the spectrum maximum correlate with the variations of solar activity. A possible relation is discussed between the observed and other manifestations of periodicity in Sun's atmospheric motions. Author

N69-22258*# Volt Information Sciences, Inc., Washington, D. C.
ON THE RELATIVE INTENSITY OF ION FE XVII LINES. EFFECTIVE EXCITATION CROSS SECTIONS OF INTERCOMBINATIONAL TRANSITIONS INTO HELIUM AND FE XVII
I. L. Beygman et al Greenbelt, Md. NASA. Goddard Space Flight Center 25 Mar. 1969 10 p refs Transl. into ENGLISH from Acad. of Sci. USSR, Lebedev Inst. of Phys. (Moscow), Preprint No. 120
(Contract NAS5-12487)
(NASA-CR-100545; ST-SPC-NP-10819) Avail: CFSTI CSCL 03B

The line intensity ratios of FE 17 in the solar corona are computed with the aid of the Coulomb-Born approximation with exchange included. It is shown that the great intensity of lines from the 3s-configuration is due to cascade radiation processes from levels of 3p and 3d– (j ≠ 1) configurations. Exchange excitation and excitation of s-electrons yields a considerable population to these levels. From comparison of theoretical line intensity ratios of transitions 3d–3p with the experimental ones, it is found that the 3d–configuration can be described by the scheme of j–j–coupling. The intercombination transitions cross-sections in He and Fe 12 are computed with the aid of the orthogonality functions method. The results are discussed and comparison is made with the experiments. The errors and misprints of work are corrected. Author

N69-22281*# Volt Information Sciences, Inc., Washington, D. C.
ON THE NATURE OF INTERPLANETARY GAS
Ye. Ya. Gidalevich et al Greenbelt, Md. NASA. Goddard Space Flight Center 25 Mar. 1969 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 117–121
(Contract NAS5-12487)
(NASA-CR-100569; ST-IS-GD-10815) Avail: CFSTI CSCL 03B

The flow of compressible gas in the gravitation field of a point body, whose gravitation potential exceeds substantially the potential of the gas itself is investigated. It is found, in the adiabatic approximation, that the gas enthalpy i is approximately equal to the gravitational potential of the body $\phi >> i_0$ (here i_0 is the enthalpy of the unperturbed gas). Accordingly, the gas density increases in the adiabatic correlation. The problem is solved applicably to the sun and to the interstellar gas. The obtained results are compared with the existing theory on the solar wind. Conclusions are derived on the nature and properties of the interplanetary gas. Author

N69-22302*# Volt Information Sciences, Inc., Washington, D. C.
OBSERVATIONS: PLANET MARS IN 1967 [NABLYUDENIYA. MARS V 1967 G]
V. A. Zinov'yev Greenbelt, Md. NASA. Goddard Space Flight Center 19 mar. 1969 5 p ref Transl. into ENGLISH from Astron. Vestn. (Moscow), v. 3, no. 1, 1969 p 57–58
(Contract NAS5-12487)
(NASA-CR-100520; ST-PS-GA-10818) Avail: CFSTI CSCL 03A

Results are given of visual Mars observations in 1966–1967 with the aid of the 30-cm refractor of the Volgograd Observatory Planetarium. By comparison with 1965, a high transmittance of planet atmosphere, the absence of clouds, and certain changes in color and detail visibility are noted. A series of drawings are presented. Author

N69-22320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW CRITERION FOR THE IDENTIFICATION OF MICROMETEOR IMPACT SITES ON ALUMINIZED GLASS
Luc Secretan and Otto E. Berg Apr. 1969 22 p refs
(NASA-TM-X-63510; X-616-69-133) Avail: CFSTI CSCL 03A

A new criterion for the identification of true impact sites by hypervelocity space particles on aluminized glass specimens is presented. The basic method of detection of these impact sites lies in the examination of post flight specimens for new perforations in the aluminum covering, and more specifically for damage or fracture of the glass substrate beneath the aluminum coating. It is shown that micron size iron particles impacting at 2–5 km/sec will fracture aluminum coated glass in a typically conchoidal pattern. Bearing in mind that the method is limited to examination of impacts by solid, structurally strong particles, this effect can serve as a criterion in the analysis of suspected hypervelocity space impacts. Absence of this fracture betrays the fact that the impacting particle lacked the structural strength, mass or velocity needed to fracture the glass. Author

N69-22323*# Volt Information Sciences, Inc., Washington, D. C.
IS THERE LIFE ON VENUS?
A. N. Kvashin et al. Greenbelt, Md. NASA. Goddard Space Flight Center 18 Mar. 1969 4 p refs Transl. into ENGLISH from Priroda (Moscow), no. 11, 1968 p 77
(Contract NAS5-12487)
(NASA-CR-100549; ST-SB-LPS-10816) Avail: CFSTI CSCL 03B

Conditions for the nascency of biological life on the surface of Venus are discussed in relation to the hypothesis of Libby and Morowitz that life is possible in the clouds of Venus. This hypothesis considers that the exchange of organisms' substance is analogous to the terrestrial one, and biochemical processes are similar, therefore life on Venus may be investigated on the basis of known terrestrial principles. A.L.

N69-22392*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
THE WORLD WIDE SPREAD OF SPACE TECHNOLOGY
E. B. Skolnikoff and J. H. Hoagland (Brown and Shaw Res. Corp.) Oct. 1968 32 p refs Submitted for publication
(Grant NGL-22-009-019)
(NASA-CR-100565; CSR-TR-69-5) Avail: CFSTI CSCL 22A

The development of space-technological capabilities in the U.S., the U.S.S.R., Western Europe, Japan, China, and the developing nations of the world is reviewed. The current stand of space technology and projected developments in France, Great Britain, Germany, Japan, and in such international efforts as ELDO and ESRO are measured against those of the U.S. and the U.S.S.R. The capabilities to produce and launch sounding rockets, satellites, and manned spacecraft are considered. Special attention is paid to the monopoly problem in connection with communication satellites. Military uses, budgetary policies, and national sentiments are discussed as well as such economic implications as spin-off effects, government subsidies to the aerospace industry, the "brain-drain", and the technology gap between nations. K.W.

N69-22393*# Volt Information Sciences, Inc., Washington, D. C.
PLANETARY ATMOSPHERE ALBEDO
V. V. Sobolev Greenbelt, Md. NASA. Goddard Space Flight Center 3 Apr. 1969 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Astron. (Moscow), v. 184, no. 2, 1969 p 318-320
(Contract NAS5-12487)
(NASA-CR-100527; ST-LPS-PA-10820) Avail: CFSTI CSCL 03B

The plane and spherical albedo of planetary atmosphere are computed assuming that the atmosphere's optical thickness is infinitely great. Applying the obtained formula for spherical albedo to planet Venus, which is 0.76 in the visible part of the spectrum, and using the value of $x = 2.1$, recently obtained by the present author, it is found that $1-\lambda = 0.0045$. Author

N69-22403# Oulu Univ. (Finland). Aarne Karjalainen Observatory.
THE REDSHIFT OF THE N-TYPE RADIO GALAXY 3 C 371
Tapani Virtanen 1969 3 p refs
(REPT-3) Avail: CFSTI

A new identification for spectral lines of the N-galaxy 3 C 371 is proposed. The resulting redshift is $z = 0.40$. Author

N69-22418# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
PROPOSED EXPERIMENTS FOR THE 6TH PLAN PERIOD [PROPOSITIONS D'ETUDES DANS LE CADRE DU 6EME PLAN]
1969 67 p In FRENCH; ENGLISH summary
(LAS-69-PJ-01) Avail: CFSTI

Proposed experiments to be carried out by the Laboratoire d'Astronomie Spatiale at Marseilles during the 6th development plan (1970-0975) are presented. These include a satellite-borne experiment to study the zodiacal light, a rocket launching program aiming at a better knowledge of the ultraviolet sky radiation, a systematic study of the zodiacal light at different wavelengths, a verification of available stellar atmospheric models by a broad band spectrophotometric analyses of hot stars, a preliminary study of the extension of galaxies and the atmospheres of hot stars. The program also includes the fabrication of a large astronomical telescope. The main aims of each research program are listed. ESRO

N69-22476# European Space Research Organization, Paris (France).
CALIBRATION METHODS IN THE ULTRAVIOLET AND X-RAY REGIONS OF THE SPECTRUM
Dec. 1968 244 p refs Partly in FRENCH; partly in ENGLISH Proc. of the ESRO Symp. held in Munich, 27–29 May 1968
(ESRO-SP-33) Avail: CFSTI

The 24 papers given at the symposium dealt with standard sources, standard detectors and calibration procedures. A number of devices were described, ranging from the hydrogen cell to the theta-pinch and from microwave cavities to the DESY synchrotron. As to standard detectors – open-structure photomultipliers, thermopiles and monochromators were described, as were the new techniques of photoelectron spectroscopy. In the course of the discussion the need was stressed for absolutely clean surfaces for reproductible measurements. Finally, the various methods and devices to calibrate sounding rocket or satellite experiments were described. For individual titles see N69-22477 through N69-22500. Author (ESRO)

N69-22490# American Science and Engineering, Inc., Cambridge, Mass.
SPECTRAL ANALYSIS OF COSMIC X-RAY SOURCES OBSERVED IN A PROPORTIONAL COUNTER
P. Gorenstein, H. Gursky, and G. Garmire (Calif. Inst. of Tech.) *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 161–168 ref (See N69-22476 11-30)
Avail: CFSTI

A method is described for deriving the spectrum of a weak cosmic X-ray source. The procedure involves two stages: the use of pulse shape discrimination to vastly reduce non X-ray background and a calculation involving an integral transform which determines the physical spectrum that best represents the X-ray data. Calibration methods are essential ingredients of both phases. The method is applied to the preliminary derivation of the spectrum of the diffuse X-ray background from data obtained on a sounding rocket. Each stage is discussed in a separate section. Author (ESRO)

N69-22483# Royal Observatory, Edinburgh (Scotland).
THE ABSOLUTE CALIBRATION OF ROCKET-BORNE STELLAR PHOTOMETERS IN THE REGION 2000–3000 Å
J. W. Campbell *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 183–190 (See N69-22476 11-30)
Avail: CFSTI

In order to compare the results of stellar surveys over a period of time it is necessary that reliable laboratory calibration standards are maintained. This is particularly important in the case of rocket astronomy, where in most cases the flight instruments are destroyed after re-entry. This paper describes the laboratory procedures adopted by the author in calibrating four stellar photometers recently flown in the ESRO programme. These instruments were aimed at obtaining absolute stellar radiation fluxes in the region 2000–3000 Å with a resolution of 200 Å. Such procedures include the measurement of spectral response, quantum efficiency and cathode uniformity for a variety of 'solar blind' photomultipliers. A comparison is also made between the use of the 'standard detector' and the 'standard source' techniques. Author (ESRO)

N69-22494# Royal Observatory, Edinburgh (Scotland).
AN ON-BOARD CALIBRATION UNIT FOR THE LIEGE-EDINBURGH ULTRAVIOLET STELLAR PHOTOMETERS IN THE TD1 SATELLITE
G. C. Sudbury *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 191–198 (See N69-22476 11-30) refs
Avail: CFSTI

The ultraviolet part of the Liège-Edinburgh stellar experiment will use the controlled scan to map the sky photoelectrically in four wavelengths in the 1200–3000 Å region. There are three reasons for requiring a calibration unit as part of the flight model. Scientifically, in-flight observations should be related to an absolute scale. There is a substantial risk of contamination vitiating the instrument in the time between full laboratory calibration and flight. Some check is needed on the continuing functioning of the detector system during integration. The EMR cold cathode xenon source is suitable for in-flight calibration and has an appropriate spectral output. A reliable compact power source is also feasible. Several alternatives are available for the optical path through the instrument; the chosen solution is a compromise based on the demands of simplicity, veracity, and the need to present a suitable flux level at the detectors. Author (ESRO)

N69-22495# Royal Observatory, Edinburgh (Scotland).
PHOTOELECTRIC CALIBRATION OF AN ULTRAVIOLET SCHMIDT CAMERA
C. M. Humphries *In* ESRO Calibration Methods in the UV and X-Ray Reg. of the Spectrum Dec. 1968 p 199–204 refs (See N69-22476 11-30)
Avail: CFSTI

The absolute intensity calibration of photographic recording stellar ultraviolet instruments using in-flight photoelectric techniques is discussed. In particular, the calibration of a dual sounding rocket experiment consisting of an objective prism Schmidt camera and an ultraviolet photometer is described. During flight, the photometer scans spatially across a portion of the 19° field of view of the camera and provides intensity calibration for the Schmidt photographic data. The spectral sensitivity of the camera extends from the visible region to 1850 Å; spectra are recorded on plates coated with Kodak SC5 emulsion. The photometer has a 2° × 0.1°kw 0.1° instantaneous field of view and its passband is determined by two multilayer dielectric reflection filters and a solar-blind photomultiplier giving a peak centered at 2800 Å with half-width about 400 Å. Pulse counting detection is used. The laboratory calibration procedure is described; preliminary results are also given, together with an assessment of the overall accuracy. The combined experiment is due to be flown in a stabilized Skylark sounding rocket during the latter part of 1968. Author (ESRO)

N69-22505*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE ORIGIN OF GALACTIC GAMMA-RAYS
F. W. Stecker Apr. 1969 6 p refs
(NASA-TM-X-63511; X-641-69-140) Avail: CFSTI CSCL 04A

A brief, critical review of the theories on gamma ray sources is presented, and it is pointed out that neither the discrete source explanation nor the proposition that gamma rays originate in Compton collisions may be proved or disproved at the present. It is shown that the same applies to the collisional production mechanisms involving interstellar gas. From 21-cm radio observations of the galaxy, it is found that the average value of the product of mean density and linear extension for emitting atomic hydrogen in the galactic disk, spread over the 15°-resolution cone of the OSO-3 detector, is approximately 3×10^{21} cm^{-2}. The collisional processes, however, would require a mean interstellar gas density in the disk of the order of 5 cm^{-3}, of which only 10% is observed in the 21-cm emission. Several arguments for the existence of such a mean density are also presented. K.W.

N69-22538# Naval Research Lab., Washington, D. C.
TABLES OF IONIZATION EQUILIBRIUM EQUATION OF STATE AT STELLAR TEMPERATURES AND DENSITIES Interim Report
Carl A. Rouse Nov. 1968 77 p refs
(AD-682195; NRL-6756) Avail: CFSTI CSCL 3/2

The screened Coulomb formulation of the ionization equilibrium equation of state is used to generate data for equation of state tables for a stellar mixture of eight elements. Two temperature-density T-rho regions are used: the T-rho region of the photosphere and low chromosphere of the sun and the T-rho region of the interior of normal stars. Information useful for detailed opacity calculations is also included. The basic ideas and formulas used are outlined. TAB

N69-22571*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF OCCULTATION AND IMAGERY PROBLEMS FOR ORBITAL MISSIONS TO VENUS AND MARS
Richard N. Green Washington Apr. 1969 84 p refs
(NASA-TN-D-5104) Avail: CFSTI CSCL 22B

A computer program for the purpose of providing mission design data for planetocentric elliptical orbits about either Mars or Venus was developed. The times at which the satellite enters into and exits from the shadows of the Sun, Earth, and Canopus are computed. In addition, the positions in orbit that correspond to desirable lighting conditions on the surface for vertical photography are computed. A program option allows for these conditions to be examined at various times by permitting the planet to proceed in its orbit about the Sun. The mean heliocentric position of the planet, the angles in the Earth-Sun-planet triangle, and the associated distances are also included in the list of output parameters. The program is written in Fortran IV language for a digital computer and contains 27 subroutines of general use. A description of the program input and output, a complete Fortran listing of the program, and samples of the input and output are included. Author

N69-22634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OXYGEN AND WATER VAPOR IN THE ATMOSPHERE OF VENUS AND MARS

V. K. Prokofev Aug. 1968 20 p Transl. into ENGLISH from Kosmos (USSR), no. 2, 1965 p 19–32
(AD-681843; FTD-MT-24-203-68) Avail: CFSTI CSCL 3/1

Investigations of the composition of the atmospheres of Venus and Mars, based on the study of airglow spectra and the spectra of the absorption of individual regions of solar radiation are reviewed. Author (TAB)

N69-22759 Kodaikanal Observatory (India).
THE EVERSHED EFFECT AND LINE ASYMMETRY IN SUNSPOT PENUMBRAE
A. Bhatnagar 1968 40 p refs *Its* Bull. Ser. A, No. 180
Copyright. Avail: Manager of Publ., Delhi: $2.97

During the two successive passages of a sunspot across the solar disk, velocity field configurations were obtained using three Zeeman insensitive lines. Large image resolution and high spectrographic dispersion were used for the determination of sight-line velocities in the spot. The observed sight-line velocities were resolved into three mutually perpendicular directions—the radial, tangential, and the vertical components. The magnitude of the maximum radial velocity component, Umax, depends on the disc position of the spot and on the strength of the line. From the knowledge of the mean depth of formation of lines in sunspot penumbrae mean gradient of Umax with depth, of the order of 4 $\times 10^{-3}$ km/sec. per km. in depth, was obtained. Author

N69-22777# Air Force Cambridge Research Labs., Bedford, Mass.
AFCRL SPACE SCIENCE RESEARCH DURING 1968 (ANNUAL REPORT TO THE SPACE SCIENCES BOARD OF THE NATIONAL ACADEMY OF SCIENCES FOR SUBMISSION TO COSPAR) Special Report, 1 Jan.–31 Dec. 1968
A. McIntyre and M. S. Tavenner 31 Dec. 1968 48 p refs
(AD-682298; AFCRL-68-0643; SR-84) Avail: CFSTI CSCL 5/2

A summary of the space science organization and facilities of Air Force Cambridge Research Laboratories (AFCRL); its international activities in space science; rockets and satellites launched during 1968; results of experiments associated with the moon, micrometeoroids, energetic particles and magnetic fields, upper atmosphere physics, meteorology, geodesy, and gravity; planned research in 1969; and a space science research related bibliography are included. Author (TAB)

N69-22877# Bonn Univ. (West Germany). Astronomische Inst.
STELLAR STATISTICAL INVESTIGATION IN THE CASSIOPEIA FIELD [STELLARSTATISTISCHE UNTERSUCHUNGEN IM CASSIOPEIA-GEBIET]
Moh. Taimur Kasimie 1968 43 p refs In GERMAN; ENGLISH summary *Its* Publ. No. 78
Avail: CFSTI

New methods of transferring stellar magnitudes from a field having accurately known magnitudes to an unknown field are investigated. In one case the magnitudes of the galactic cluster NGC 744 as derived from the density curve of the transferred cluster NGC 957 is compared to the known photoelectric UBV magnitudes of NGC 744. In the second case UBV magnitudes of field stars are determined both from the transferred density curve and the directly observed density curve of NGC 957. In one case the mean magnitude is taken from the individual magnitudes of each plate, in another the mean of individual density measures is taken before deriving the magnitudes. The second method is the better one. The interstellar absorption in the field under study in Cassiopeia was determined from the reddening of stars with known spectral types and those stars that could be uniquely classified by the two color method. From about 1870 stars the density functions of different spectral groups were determined. The open cluster King 4 is located at a distance of 1.69 – 1.92 kpc as found from the two color and the short and long wavelength color magnitude diagrams. Author

N69-22878# Bonn Univ. (West Germany). Astronomische Inst.
PHOTOMETRIC INVESTIGATION OF THE OPEN STAR CLUSTER NGC 6231 [PHOTOMETRISCHE UNTERSUCHUNG DES OFFENEN STERNHAUFENS NGC 6231]
Wilhelm Seggewiss 1968 35 p refs In GERMAN; ENGLISH summary *Its* Publ. No. 79
Avail: CFSTI

The open cluster NGC 6231 which constitutes the nucleus of the association Sco OB 1 was investigated photometrically. Thirty stars in NGC 6231 were measured to establish a photoelectric scale. With the same instrument 29 stars of the Harvard Standard Regions E 2, E 7, and E 9 were observed for transformation of the instrumental color system to the UBV system. Star counts in the area of the cluster lead to an angular diameter of 26 minutes of arc. In this area 290 starts to the limiting magnitude V = 15^{m}2 were measured with the iris photometer. Main sequence fitting using the long wavelength and short wavelength color magnitude diagrams and the two color method gave the color excess (E_{B-V}) 0^{m}42 and the true distance modulus 11^{m}24, corresponding to a distance of about 1750 pc. Cluster members and field stars were separated on account of their location in the two color and color magnitude diagrams. New absolute magnitudes were determined for 36 early type giants in the area of Sco OB1. The course of interstellar absorption with distance was determined from the reddening of field stars. The association and its nucleus are located in the Sagittarius arm of our galaxy. Proper motions in the region of Sco OB 1 were used to determine the absolute proper motion of NGC 6231. The proper motion component in the direction of galactic latitude corresponds to the unusually high velocity of 42 km/sec perpendicular to the galactic plane. Author

N69-22905*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEPENDENCE OF THE LUNAR WAKE ON SOLAR WIND PLASMA CHARACTERISTICS
K. W. Ogilvie and N. F. Ness Mar. 1969 20 p refs Submitted for publication
(NASA-TM-X-63513; X-616-69-94) Avail: CFSTI CSCL 03B

Simultaneous measurements in cislunar space of the characteristics of the solar wind plasma as observed by Explorer 34, and the perturbed magnetic field in the lunar wake as detected by Explorer 35, were performed. The plasma parameter for the ions was found to be more important in determining the magnitude of the umbral positive and penumbral negative anomalies than the direction of the interplanetary magnetic field. A quantitative comparison was made of these observations with the lunar wake theory of Whang.

N69-22918*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TANGENTIAL DISCONTINUITIES IN THE SOLAR WIND
L. F. Burlaga and N. F. Ness Apr. 1969 27 p refs Submitted for publication
(NASA-TM-X-63515; X-616-69-143) Avail: CFSTI CSCL 03B

Six discontinuity surfaces which were observed by magnetometers on 3 spacecraft in the solar wind are considered. It is shown that the actual surface orientations, determined from the measured time delays and solar wind speed, are consistent with the theoretical orientations which were computed from the relation $n = B \times B'$, where n is the normal to the surface of a hydromagnetic tangential discontinuity across which the magnetic

field direction changes from B to B'. The plasma and magnetic field data for these discontinuities are consistent with the pressure balance condition, and the magnetic field vectors in the associated current sheets are parallel to the discontinuity surface, as required theoretically. The 6 discontinuity surfaces extended without much distortion over ≈.002 AU. A seventh surface is discussed which satisfied the condition n = B×B' but which extended without much distortion over 0.02 AU. Most of the surfaces tended to lie along the spiral direction, but one was nearly perpendicular to the spiral direction. Author

N69-22921# Oulu Univ., (Finland). Aarne Karjalainen Observatory.
A RE-EXAMINATION OF DANJON'S OBSERVATIONS OF THE PLANET MERCURY
Toivo Jaakkola 1969 17 p refs
(REPT-1) Avail: CFSTI

Danjon's measurements on Mercury's integrated brightness are reexamined. Its phase curve turns out to be asymmetrical with respect to the zero phase. This phenomenon may partially be explained by two bright spots on the opposite sides of the planet but a residual asymmetry remains unexplained. Author

N69-22939*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF CLOUD COVER ON SELECTION OF RECOVERY SITES FOR FUTURE EARTH ORBITAL MISSIONS
Paul F. Holloway Washington Apr. 1969 20 p refs
(NASA-TN-D-5120) Avail: CFSTI CSCL 04B

Climatological summaries are shown to be very useful as a site-selection constraint. A possible global recovery network has been proposed which can be considered as a nucleus for most future earth orbital recovery operations. This analysis has been based on climatological summaries of the probability of 3/10 or less cloud cover. A cursory analysis of other weather conditions at the sites, such as surface winds, ceiling height, gusts, and air turbulence, has indicated that no particular conditions might be expected which would rule out any of the recommended recovery sites from future consideration. Author

N69-22948*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
THE VINTI DYNAMICAL PROBLEM AND THE GEOPOTENTIAL
Diarmuid O'Mathuna Washington Apr. 1969 86 p refs
(NASA-TR-R-307) Avail: CFSTI CSCL 03C

A solution of the Vinti dynamic problem is derived in a form that is a clear generalization of the standard form of solution of the Kepler problem. Some geometrical results on the orbits are given together with a physical model for the potential. Author

N69-23008# Oulu Univ. (Finland). Aarne Karjalainen Observatory.
THE SURFACE STRUCTURES OF THE MOON AND MERCURY DERIVED FROM INTEGRATED PHOTOMETRY
Tapani Pikkarainen 1969 14 p refs
(Rept-2) Avail: CFSTI

The integrated brightnesses of the Moon and Mercury are theoretically calculated by using a surface model with parabolic holes, Lommel-Seeliger's reflection law and the phase function of irradiated basalt powder. The theoretical integrated brightnesses are fitted with observations by using two free parameters which describe the surface structures of the Moon and Mercury. The results show that Mercury's surface is more densely covered with holes but that their depths are smaller than on the Moon. Author

N69-23135*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
EFFECT OF 2 < λ < 12 Å SOLAR X-RAYS ON THE IONOSPHERE BETWEEN 60 AND 100 km
P. R. Sengupta Mar. 1968 61 p refs
(Contract NAS5-9076)
(NASA-CR-100604; Rept-68-17) Avail: CFSTI CSCL 03B

Computations were made in order to evaluate the ionospheric effects caused by the observed 2 < λ < 8 Å X-ray quiescent flux and flare flux. Of seventy-two solar X-ray flares having F(2-12 Å) greater than 3×10^{-3} erg/cm^2 sec as recorded by Explorer 33, sixty-seven are found to be accompanied by reported S.I.D's in which the electron density of the ionosphere between 60 to 100 km undergoes a rapid increase during a few minutes. These rapid increases in electron density are presumably caused by the enhanced X-ray flux in the wavelength range 1 < λ < 10 Å because softer X-rays would be completely absorbed above 100 km and harder X-rays would penetrate below 60 km without significant attenuation at higher altitudes. The altitudes for peak electron production range from 99 km for 10 Å X-rays down to 58 km for 1 Å X-rays. The electron production rate equations were solved using a quiescent X-ray energy spectrum and a mean flare X-ray energy spectrum. Author

N69-23158# Lockheed Missiles and Space Co., Palo Alto, Calif.
ORBIT INCLINATION
D. Zhemchuzhin et al 1969 3 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), No. 2, 1969 p 41
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Orbit inclination, the angle between a plane drawn through the earth's equator and the plane in which the satellite moves during flight, is discussed as to its properties and its value for space research. It is noted that orbit inclination is the only orbit parameter of which the value remains practically constant throughout the satellite's lifetime. It cannot be less than the latitude of the liftoff point if the satellite does not perform special maneuvers. Orbit inclination determines the change in position of the orbit plane in absolute space, a circumstance utilized to regulate this position during satellite flight. In addition, orbit inclination governs the geographical latitudes over which the satellite flies, the regions of the earth's surface from which it can be launched, and the motion of the perigee during flight. P.A.B.

N69-23161*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
FIRST-ORDER PLANETARY THEORY. PERTURBATIONS IN RECTANGULAR COORDINATES, HANSEN'S VARIABLES, LONGITUDE, AND DISTANCE
S. E. Hamid 3 Sep. 1968 244 p refs
(Grant NGR-09-015-002)
(NASA-CR-100680; SAO Special Rept-285) Avail: CFSTI CSCL 03C

A general computer program to compute the first order theory, using the Brouwer method for calculating perturbations in rectangular coordinates, was constructed. Literal expansion of the various functions involved was avoided, being replaced by single and double harmonic analysis techniques. The program's input consists of the sequence number of the perturbing and perturbed planets and the number of points used in the harmonic analysis. The output is the Fourier series representation of the first order perturbations in the rectangular coordinates. Two approaches for solving for the constants of integration are incorporated into the program. It is so constructed that it can compute higher order terms once the first order terms are available. After applying the program to compute the first order theory of Mars as perturbed by the other planets, an analytical comparison was made with other

data and found to be in good agreement. Computed results for the first order perturbations of all the planets excepting Pluto are included in tabular form. P.A.B.

N69-23187# Nuclear Energy Information Center, Warsaw (Poland).
ISOTOPIC AND ELEMENTAL COMPOSITION OF METEORITES: A BIBLIOGRAPHY, 1947–1967
J. Kielbasinki and J. Wanat 1968 133 p refs
(NEIC-RR-32) Avail: AEC Depository Libraries

One thousand and eighteen references to papers published in the years 1947–1967 are presented. They are arranged chronologically according to year, and within a year they are ordered alphabetically according to the name of the first author. A subject index was completed on the basis of the titles of the papers. NSA

N69-23188# Observatoire de Paris (France).
OPTICAL POSITIONS OF BRIGHT GALAXIES [POSITIONS OPTIQUES DE GALAXIES BRILLANTES]
L. Gallouet and N. Heidmann 1968 18 p refs
Avail: CFSTI

Radioelectric measurements of about a hundred bright galaxies have been made with a few minutes of arc antenna patterns. Optical and continuum or 21 cm emissions were compared. However, it appears that optical positions of galaxies are much less precise than radio positions. The optical positions of the hundred brightest galaxies, as given in the main available catalogues were found to have a r.m.s. error, excluding 6 cases where errors exceeded 5', This might be a consequence of reducing errors, typographical mistakes, or may simply be due to the wide and often badly defined galaxian images. The optical positions were measured of the whole of de Vaucouleurs and de Vaucouleurs catalogue galaxies visible on the blue *Palomar Sky Survey* paper prints of Paris Observatory, i.e. 2,115 objects. A first list 278 galaxies the coordinates of which are in the zone 06h 30m to 18h 30m and 12° to 25°, is included. Author

N69-23205*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VIEWING THE EARTH-MOON LAGRANGIAN POINTS L4 AND L5 FROM AN OBSERVATION BALLOON AND FROM THE ATM USING S-052
Larry Mullins 26 Feb. 1969 59 p
(NASA-TM-X-53919) Avail: CFSTI CSCL 03A

A method is proposed for determining when the moon and libration points L4 and L5 will come within the field of view of a high altitude observing instrument (S-052). This experiment is scheduled for a 1969 balloon flight and the planned Apollo telescope mount (ATM) flight. A line-of-sight vector is established from the observing instrument aboard both vehicles to the sun, moon, L4, and L5. Calculations using a basic coordinate system show that opportunities for observing the libration points occur twice each year. Calculations are given for the flight path angle, azimuth, latitude, longitude, inclination, and altitude of the ATM in orbit. B.G.D.

N69-23222 Kodaikanal Observatory (India).
THREE WOLF-RAYET BINARIES
K. S. Ganesh and M. K. V. Bappu 1968 17 p *refs Its* Bull. Ser. A, No. 185
Copyright. Avail: Manager of Publ., Delhi: $1.16

Radial velocities and line profiles are studied of three Wolf-Rayet binaries: HD 193928, HD 186943, and HD 211853. A new orbit is determined for HD 193928 from radial velocity measures of HeII 4686. Line profile variations with phase of the emission lines are described. This system is likely to have an orbital inclination that will enable the detection of eclipses. A revised period of 9.5594 days is derived for HD 186943. Orbital elements are derived using velocity curves HeII 4686, NV 4603, and NIV 4058. For HD 211853, preliminary elements are derived using the same velocity curves. The observations are discussed in terms of some of the current ideas concerning the nature of the Wolf–Rayet phenomenon. Author

N69-23285 Kodaikanal Observatory (India).
THE WOLF–RAYET ECLIPSING BINARY HD 193576
K. S. Ganesh, M. K. V. Bappu, and V. Natarajan 1968 9 p refs *Its* Bull. Ser. A, No. 184
Copyright. Avail: Manager of Publ., Delhi: $0.87

Low dispersion spectra (75 Å/mm at 4300 Å) of HD 193576 were utilized for radial velocity measures as well as line profile determinations of some of the emission lines. Using such measures for HeII 4686, the elements derived are γ-axis = + 16.2 km/sec, K = 282.8 km/sec, e = 0.11, ω = 163°. The velocity measures of NIV 4058 are combined with earlier measures of Munch to yield the following values: γ-axis (NIV 4058) = − 41.5 km/sec, K = 302.6 km/sec, e = 0.09, ω = 130°, T_o = 0.26, T = 0.62. The velocity measures of the absorption lines 4340 Å and 4100 Å that originate from the O component show much scatter. A combination of the K values of NIV 4058, Hδ yield masses of the O and W stars as 23.3 and 8.2 solar masses respectively. If 4058 Å is used with the K value derived by Munch from measures of the higher members of the Balmer series, these are 25.0 and 9.9 solar masses respectively. Line profiles of 4058 Å, 4686 Å, 4861 Å from low dispersion spectra are discussed. A few coude spectrograms (10 Å/mm) of this star were obtained at primary and secondary minima and outside eclipse. The emission line NIV 3483 shows a violet absorption edge at primary minimum. Profiles of H9, H11 and H13 show clearly the increase in width at primary minimum caused by electron scattering. The intensities of the hydrogen lines are also found to increase slightly at this phase. Author

N69-23286 Kodaikanal Observatory (India).
THE WOLF-RAYET BINARY HD 68273
K. S. Ganesh and M. K. V. Bappu 1968 14 p refs *Its* Bull. Ser. A, No. 183
Copyright. Avail: Manager of Publ., Delhi: $0.92.

A series of 127 spectrograms of this binary obtained at Kodaikanal during 1965 and 1966 were used for a study of radial velocities of the emission and absorption lines. The period is found to be 78.5 days. The spectral type of the O component is O7.5 as determined from a single high dispersion Mount Stromlo coude spectrogram. The velocity curves of the Wolf-Rayet component are determined for HeII 4686, the CIII complex at 4652Å and CIV 4441. The velocity curve for the O component is from measures of the absorption line Hδ. Arguments are presented to show that the velocity curve of CIII 4652 is the best suited for the study of masses of the components. The eccentricity of the orbit is 0.17. The gamma-axis for HeII 4686 is redshifted with respect to that of Hδ by 82 km/sec. The values of $m_o \sin^3 i$ and $m_w \sin^3 i$ are 46.3 and 13.0 solar masses respectively. The inclination of the orbit is likely to be such that the system exhibits eclipses. The W-component seems to be the most massive yet known among the very small group of Wolf-Rayet stars. Author

N69-23287 Kodaikanal Observatory (India).
TWO COLOUR PHOTOELECTRIC OBSERVATIONS OF THE ECLIPSING VARIABLE UW CANIS MAJORIS
A. T. Doss 1968 9 p refs *Its* Bull Ser. A, No. 182
Copyright. Avail: Manager of Publ., Delhi: $0.58

Photoelectric light curves of the eclipsing binary UW Canis Majoris were obtained in the blue and yellow. A new ephemeris is given for the system. The depth of the primary minimum is about $0^m.45$ in B and $0^m.47$ in V and that of the secondary is about $0^m.43$ in B and $0^m.42$ in V. Author

N69-23288 Kodaikanal Observatory (India).
PHOTOELECTRIC LIGHT CURVE OF IYY ERIDANI
J. C. Bhattacharyya 1968 16 p refs /*ts* Bull. Ser. A, No. 181
Copyright. Avail: Manager of Publ., Delhi: $1.30

Photoelectric light curves in B and V of the W Ursa Majoris star YY Eridani were determined. Gradual lengthening of the period was observed. Author

N69-23301# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF OPTIMUM RENDEZVOUS MODES OF SPACE VEHICLES
Iu. G. Sikharulidze 1969 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 7, no. 1, 1969 p 35–41
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The problem of the rendezvous of a maneuverable space vehicle with a satellite is considered. In an exact formulation of the problem, the character of the energetically optimal and the optimal fast response rendezvous is determined for an arbitrary satellite orbit. The greatest possible number of thrust switchings for a coplanar rendezvous with a satellite in circular orbit is investigated in the linearized problem. Author

N69-23306# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF IMPULSES FOR SATELLITE RENDEZVOUS IN A CENTRAL NEWTONIAN GRAVITATIONAL FIELD
Iu. A. Ermilov 1968 7 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 840–846
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Final formulas describing the dependence of the required velocity increments on the initial conditions and transfer time for satellite rendezvous are derived by the method of free trajectories, or two-impulse ballistic transfer. The solution is based on utilizing the constants of integration of the linearized equations of relative motion in coordinates referred to the variable magnitude of the planetocentric radius-vector of the target satellite. Author

N69-23324# Lockheed Missiles and Space Co., Palo Alto, Calif.
PLANET FLYBY TRAJECTORIES WITH A RETURN TO EARTH
V. R. E. Bauze et al [1968] 10 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 803–811
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A method is presented for computing nearby flyby trajectories around planets, taking into account their perturbing effect with the vehicle's subsequent return to earth. The singularities of Venus and Mars flyby trajectories is investigated as a function of the total flight time and the flight range to the planet. Specific trajectories are considered. It is shown that for a flight to Venus in 1967, the escape velocity from earth to assure a return would exceed negligibly the values of optimal flight velocities without any return. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-22172*# Techtran Corp., Glen Burnie, Md.
AN ANALYTICAL APPROACH TO THE PROBLEM OF THE ACCESSIBLE DOMAIN OF A RE-ENTRY GLIDER
Jean Faye Washington NASA Mar. 1969 23 p refs Transl. into ENGLISH from Rech. Aerospatiale (Chatillon-sous-Bagneux), May–Jun. 1968 p 3–11
(Contract NASw-1695)
(NASA-TT-F-12158) Avail: CFSTI CSCL 22C

Optimal paths permitting a re-entry glider, flying with a modulation of the angle-of-attack and of the bank angle to reach a final point on the boundary of its footprint are studied with the hypothesis of equilibrium flight-paths (low slope angle). The notion of maneuverability domain yields the analytical expression of optimal control laws with respect to the velocity, chosen as independent variables, and state variables, through the intermediary of a non-constant component of the prime vector. Optimal paths are then calculated, by numerical integration of equations, with these optimal laws. The optimal angle-of-attack always corresponds to a maximum lift-to-drag ratio. The optimal bank angle laws are different according to the point of the footprint boundary aimed at: for maximum lateral range, the bank angle decreases monotonically from its maximum value to zero. The minimum longitudinal range point, on the symmetry axis of the footprint, is obtained with maximum bank angle and only one switch, from one direction to the other. Author

N69-22240*# National Aeronautics and Space Administration, Washington, D. C.
IMPROVED LUNAR CARGO AND PERSONNEL DELIVERY SYSTEMS
L. L. Morgan (Lockheed Missiles and Space Co., Sunnyvale, Calif.) and Rodney W. Johnson *In its* 6th Ann. Meeting of the Working Group on Extraterrest. Resources 1968 p 173–191 ref (See N69-22226 11-30)
Avail: CFSTI CSCL 22B

Two principal flight modes for personnel delivery were investigated: lunar orbit rendezvous (LOR) and direct flight. The LOR mode is basically the same as the Apollo flight mode, with the exception that surface staytimes of up to 90 days were investigated. Staytimes in this range require that the command and service module (CSM) remain unmanned and dormant in lunar orbit for 90 days and that the lunar module (LM) remain unmanned and dormant on the lunar surface for 90 days. The delivery of three men can be achieved with this system. In the direct flight mode the earth return stage, with a command module and its service support, is landed on the lunar surface for direct return to earth. When a landing site is located at latitudes off the lunar equator, an extended staytime results in the landing site moving out of the plane of the orbit; this requires a plane change for pickup of the LM ascent stage except at the times of intersection of the landing site and the orbit plane. The direct-flight mode eliminates the requirement for large plane changes and, hence, fuel expenditures in accomplishing the rendezvous and docking maneuvers. Author

N69-22251*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TOS EVALUATION CENTER (TEC) POSTOPERATIONAL TEST RESULTS FOR ESSA 4
Robert R. Golden, Duane A. Kaeding (RCA, Princeton, N. J.), and David E. Briggs (RCA, Princeton, N. J.) Jan. 1969 64 p
(NASA-TM-X-63501; X-481-69-37) Avail: CFSTI CSCL 22C

A program of four groups of progressively hazardous tests was initiated after the usefulness of ESSA 4 as an operational spacecraft ceased in late 1967 due to failure of the two cameras and the digital solar-aspect indicator. Specifically, the tests were to: (1) determine the degradation of spacecraft subsystems as compared with performance at launch checkout; (2) exercise commands and subsystems not previously used; (3) ascertain the thermal and power limitations of TOS spacecraft; and (4) use ESSA 4 as a test vehicle in special investigations of the command and control systems. This report describes the tests and the condition of the following subsystems: programmers, beacon transmitters, horizon crossing indicators, regulators, TV transmitters, magnetic controls, cameras, command tone, the digital solar-aspect indicator, and the housekeeping T/M commutators. K.W.

N69-22329*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENVIRONMENTAL TEST PROGRAM FOR THE RADIO ASTRONOMY EXPLORER-A (RAE-A)
Royal M. Tysdal Mar. 1969 90 p refs
(NASA-TM-X-63502; X-326-69-59) Avail: CFSTI CSCL 22B

Environmental testing of the RAE-A spacecraft was performed between September 1967 and May 1968. The test program used a proto-flight spacecraft to qualify the design and establish flight worthiness of the spacecraft. Testing was performed in accordance with environmental test requirements for Delta launched spacecraft and apogee kick motor. Proto-flight spacecraft tests revealed 22 malfunctions. The most significant malfunctions during the test program appeared early during the thermal–vacuum test phase and revealed several subsystems whose design control drawings were out of data which resulted in wrong capacitors being installed. After replacing the capacitors, no further trouble was encountered with these subsystems. Author

N69-22340# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
FLIGHT TESTING OF THE GERMAN ASTRIS STAGE BY MEANS OF THE CORA 2 LAUNCH VEHICLE [EXPERIMENTATION EN VOL DE L'ETAGE ALLEMAND ASTRIS A L'AIDE D'UN ENGIN CORA 2]
J. Terracol 24 Jan. 1969 33 p refs In FRENCH
(Contract SEREB/ELDO-13/44)
(LRBA-NT-4/69/SEN) Avail: CFSTI

In case the ELDO F-launching program was cancelled the possibility of flight-testing the German third stage ASTRIS with a CORA 2 vehicle was examined and it was shown that some modification of the characteristics of these stages alone would be required. In order to ignite the ASTRIS stage correctly, and to ensure its proper separation and guidance thereafter, it would be necessary to ensure that the aerodynamic characteristics at that time were not unfavorable. Several configurations are analyzed so as to obtain a convenient separation altitude without encountering adverse attitude control conditions for the French modified first stage. ESRO

N69-22391*# Volt Information Sciences, Inc., Washington, D. C.
COMPARISON OF THE THEORY OF MOTION OF REMOTE ARTIFICIAL EARTH'S SATELLITES WITH OBSERVATIONS [SRAVENIYE TEORII DVICHENIYA DALEKIKH ISZ S NABLYUDENIYAMI]
V. P. Dolgachev Greenbelt, Md. NASA. Goddard Space Flight Center 10 Apr. 1969 10 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 3: Fiz.-Astron. (Moscow), v. 1, 1969 p 81–86
(Contract NAS5-12487)
(NASA-CR-100514; ST-CM-10824) Avail: CFSTI CSCL 22B

The analytical expressions for secular and long period perturbations of orbits of remote artificial earth satellites are utilized for the computation of perturbations of certain real earth satellites. The results of calculations by analytical dependences are further compared with the results of numerical integration of satellite equations of motion in the gravitational field of the moon. Author

N69-22426# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
POSSIBLE PAYLOAD TRANSPORT INTO THE 24-H-ORBIT OF THE EUROPA 2 ROCKET AND SOLAR-ELECTRIC PROPULSION MODULE [MOEGLICHKEITEN DES NUTZLASTTRANSPORTES IN DIE 24-H-BAHN MIT DER EUROPA 2 UND SOLAR-ELEKTRISCHEM ANTRIEBSMODUL]
Wolf Rasch and Wolfgang Scharf 16 Dec. 1968 34 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-83) Avail: CFSTI

Increasing the payload capacity to the 24-h-orbit of the Europa 2-rocket from 170 kg to more than 500 kg, by means of a solar-electric propulsion-module is discussed. The optimum lay-out of the thrustor is determined for a minimum transfer time, and existing electrostatic thrustors are analysed. With an adapted electrostatic thrustor a sound broadcasting satellite may be brought to the 24-h-orbit. This satellite is able to radiate three VHF-programs, which are received all over Europe by means of inexpensive pocket transitor sets. Author

N69-22474# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Inst. für Angewandte Gasdynamik.
INVESTIGATIONS OF THE TRANSONIC AND SUPERSONIC AERODYNAMIC CHARACTERISTICS OF TWO LIFTING REENTRY CONFIGURATIONS [UNTERSUCHUNGEN AB ZWEI MODELLEN VON STEUERBAREN WIEDEREINTRITTSFLUGKOERPERN IM TRANSSCHALL- UND UEBERSCHALLBEREICH]
H. Esch Oct. 1968 55 p In GERMAN; ENGLISH summary Sponsored by Bundesmin. für Wiss. Forsch.
(BMWF-FBW-68-68) Avail: CFSTI

A wind-tunnel investigation has been made to evaluate the transonic and supersonic aerodynamic characteristics of two lifting reentry configurations. Since both vehicles will fly mostly at hypersonic speeds, and since the problems associated with hypersonic speeds are the more severe, the present investigation cannot be taken as basis for deciding which of the two configurations is the more suitable. Thus, the main purpose of the tests was to investigate whether the models were controllable for Mach numbers $0.5 < M < 4.5$. Besides the measurement of drag, lift, and longitudinal stability some tests were made concerning the directional stability, the rudder effectiveness and the magnitude of the hinge moments of the elevons. Author (ESRO)

N69-22830*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SCALED LUNAR MODULE JET EROSION EXPERIMENTS
Norman S. Land and Harland F. Scholl Washington Apr. 1969 42 p refs Supplement Number L-1043 to this report is available on loan from Langley Research Center
(NASA-TN-D-5051) Avail: CFSTI CSCL 22B

An experimental research program was conducted on the erosion of particulate surfaces by a jet exhaust. These experiments were scaled to represent the lunar module during landing. A conical gold-gas nozzle simulating the lunar module nozzle was utilized. The investigation was conducted within a large vacuum chamber by using gravel or glass beads as a simulated soil. The effects of thrust, descent speed, nozzle terminal height, particle size on crater size, and visibility during jet erosion were determined. Results indicate that, from an erosion and visibility standpoint, the best landing mode for a lunar module type of vehicle would involve: site inspection and selection above the incipient erosion height, and a fast descent to the highest drop-in altitude that the vehicle structure could withstand. A slow and cautious descent with hovering just above the lunar surface would greatly increase crater size and impair visibility. Author

N69-22801# Royal Aircraft Establishment, Farnborough (England).
SPATIAL SURVEILLANCE OF NATURAL RESOURCES
D. I. Raitt, comp. Jan. 1969 24 p refs
(RAE-LIB-BIB-308) Avail: CFSTI

This selective bibliography, arranged alphabetically by author, covers the period 1944 to date. In general the coverage is of the following fields: mineral deposits, agriculture (vegetation, groups, soils), forestry (disease, fire), wildlife, livestock, and water resources. A select list of references on applications satellites is also included. Author

N69-22813*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
APPLICATIONS TECHNOLOGY SATELLITE GRAVITY GRADIENT STABILIZATION SYSTEM Quarterly Progress Report, 1 Nov. 1968–28 Feb. 1969
20 Feb. 1969 13 p refs
(Contract NAS5-9042)
(NASA-CR-100610; Doc-69SD4256) Avail: CFSTI CSCL 22B

The status of the design, test, and flight analysis of ATS-2, ATS-4, and ATS-E is documented in the form of an events summary. It is reported that: interlocked damper boom elements were developed, tested, and incorporated into the ATS-E combination passive damper/damper boom system; the ATS-E TV flight cable was lengthened; a series of design reviews on the primary boom system were undertaken, and thermal flutter investigations were concluded. P.A.B.

N69-22843# Office National d'Etudes et de Recherches Aerospatiales, Paris.
INTERACTIONS BETWEEN A SATELLITE AND THE IONOSPHERE APPLICATIONS TO DRAG AND PROBE MEASUREMENT PROBLEMS [INTERACTIONS D'UN SATELLITE AVEC L'IONOSPHERE ET APPLICATIONS AUX PROBLEMES DE TRAINEES ET DE MESURES PAR SONDES]
Gerard Fournier 1969 33 p refs In FRENCH; ENGLISH summary
(ONERA-NT-142) Avail: CFSTI

Documents dealing with the perturbations of a collisionless plasma due to a hypersonic conducting body are analysed. The fundamental assumptions are discussed and the main results presented. This study brings out several directions of research to be explored, the most important being the determination of the electronic and ionic densities, and of the equipotentials in the wake, with and without magnetic induction, as well as the stability of the flow and the wave genration. Author

N69-22937*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL BENDING STRENGTH OF AN ATLAS LV-3C BOOSTER BEYOND COMPRESSIVE SKIN WRINKLING
Robert P. Miller Washington Apr. 1969 57 p refs
(NASA-TN-D-5166) Avail: CFSTI CSCL 22B

Three bending-strength tests were performed at Lewis Research Center, on a full-scale Atlas LV-3C booster to determine the bending strength available after the start of compressive wrinkling of the vehicle tank skin. Experimental data are compared with analytical predictions and show a good correlation. A description of these tests, the test results, and a method of analytically evaluating postwrinkling bending of thin-walled pressure-stabilized cylinders are presented. Author

N69-22974*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
PROJECT STRATUM
6 Dec. 1967 116 p ref
(Contract NASr-54(13))
(NASA-CR-100587) Avail: CFSTI CSCL 22B

STRATUM (Stratified Thermosphere Research AT the University of Michigan) is a satellite system which provides support for an experiment designed to measure the atomic and ionic composition, electron density, and intensity of airglow phenomena. Six scientific instruments (a retarding potential mass analyzer, a mass spectrometer, a Langmuir probe, a resonance relaxation probe, an impedance ion mass spectrometer, and an airglow photometer) will measure the desired quanties. The nature of the experiments requires: (1) prevention of experiment contamination of outgassing; (2) solution of the thermal problem introduced by high power dissipation, polar orbit, and stabilization; (3) attitude sensing ± 2 degrees throughout entire mission; and (4) necessary three-axis stabilization ± 20 degrees. The satellite is to be launched early in 1970. This report describes spacecraft configuration and structural design, orbit determination, stabilization, attitude sensing, power supply, thermal control, communications and data processing, instrument placement, the Scout launch vehicle, the yo-yo despin, reliability, and costs. Author

N69-23139*# National Aeronautics and Space Administration, Washington, D. C.
CODE NAME SPIDER, FLIGHT OF APOLLO 9
1969 19 p
(NASA-EP-68) Avail: SOD $0.40 CSCL 22B

This booklet on the Apollo 9 flight gives illustrations and details of the breakaway and docking of Gumdrop (command service module) and Spider (lunar module). Included are photographs of the two separate vehicles in flight and photographs of the crew and the earth surface taken by the astronauts. B.G.D.

N69-23159# Lockheed Missiles and Space Co., Palo Alto, Calif.
SPACE VEHICLE RENDEZVOUS FOR A CONSTANT DIRECTION OF THE RELATIVE RANGE VECTOR
G. V. Samodovich 1968 8 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 6, no. 6, 1968 p 847–854
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The relative motion of a space vehicle which satisfies conditions of the parallel approach method is considered. A law for the change in additional force needed to realize this method is obtained. As an illustration, appropriate energy expenditures are estimated for some modifications of the initial conditions. Author

N69-23175# Weapons Research Establishment, Salisbury (Australia).
THE DYNAMIC STABILITY OF A ROLLING FLEXIBLE MISSILE
A. R. Glasson Dec. 1968 19 p refs
(WRE-TN-HSA-138) Avail: CFSTI

Using the Aero High sounding rocket as an example, it is shown that lateral vibrations play an important part in determining conditions for the stability of a rolling flexible missile. The missile is represented by a discrete twenty-mass model, and the shape of the missile is approximated by three of its free–free modes. The equations of motion are linearized by assuming that the forward velocity, dynamic pressure and roll rate are constant; second order terms in the elastic displacements, lateral velocities, pitch rate, and yaw rate are neglected. Numerical results obtained from computer programs indicate that the two major effects of flexibility are: (1) to restrict the values of dynamic pressure at which motion is stable, and (2) to reduce the values of roll rate at which motion is stable. Author

N69-23283# Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Dept.
RADIOACTIVE FUEL CAPSULE IMPACT DATA
G. H. Elkins Aug. 1968 52 p refs Sponsored by AEC
(SC-RR-68-528) Avail: CFSTI

Containment of the radioactive fuel in a radioisotope heat source (capsule) under impact conditions is an area of major concern in aerospace nuclear safety. During the past few years, a large number of impact tests of radioisotope capsules were conducted. A compilation of the data resulting from these tests is presented. The following parameters are presented for each impact test: impact velocity, capsule temperature at impact, impact angle, capsule failure or survival, target material, capsule description, capsule material, and source of data. Survival or failure of a specific capsule is as defined in the reference from which the data were obtained. Author (NSA)

N69-23348# Lockheed Missiles and Space Co., Palo Alto, Calif.
MEANS OF RESCUING A SPACECRAFT CREW
D. Ivanov et al 1969 5 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 2, 1969 p 42–43 Submitted for publication
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Discussions are presented on the free fall of a flying vehicle and the possibilities of using braking parachutes. A one man compression chamber provided with necessary emergency equipment was proposed for use during long space flights. Research was done on a rescue capsule that would assure the life-support and safe return of a crew of an orbital spacecraft for any emergency situation that might arise during flight. B.G.D.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-21963 Case Western Reserve Univ., Cleveland, Ohio.
FINITE DEFLECTION, DISCRETE ELEMENT ANALYSIS OF SHELLS
Frederick Karl Bogner (Ph.D. Thesis) 1967 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-10142

A discrete element analysis capability for predicting the nonlinear response of thin elastic shells is presented. The displacement patterns for a shell element, the edges of which must be parallel to orthogonal curvilinear coordinates, are expressed in terms of products of one-dimensional Hermite interpolation polynomials and undetermined nodal displacement parameters. Geometric admissibility of the displacement state of an assemblage of these discrete elements is conveniently satisfied. Special treatment is given to the particular cases of flat rectangular plate and circular cylindrical shell discrete elements. The use of a potential energy principle permits the incorporation of geometric nonlinearity, thus providing the capability for predicting finite displacements and post-buckling behavior. Dissert. Abstr.

N69-21967 Stanford Univ., Calif.
DYNAMICS OF ELASTICALLY-CONNECTED RIGID BODIES SUBJECTED TO LARGE SUPPORT MOTIONS
Jamnadas Gokaldas Ved (Ph.D. Thesis) 1968 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-11370

The dynamic response of a system of rigid bodies connected by a space frame structure subjected to large support motions is investigated. The equations of motion are derived in matrix form using Lagrange's form of D'Alembert's principle and the structural stiffness matrix. A computer program was developed to generate the stiffness matrix of the structure and to solve the differential equations of motion by numerical integration. Numerical studies of several examples are presented to demonstrate applications of the method. The contribution of the nonlinear terms is studied for systems subjected to large rotations of the supports. Various positions of the axes of rotation with respect to mass centers of the bodies were studied. Simplifying the analysis by linearizing the equations of motions was considered. Dissert. Abstr.

N69-21968 California Univ., Los Angeles.
ON VARIATIONAL FORMULATIONS FOR OPTIMAL STRUCTURAL DESIGN
David Salinas (Ph.D. Thesis) 1968 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-11883

This thesis treats the minimum weight optimum design problem of elastic structural mechanics. The optimization problem is formulated by the calculus of variations. The statement of the problem leads directly to the extremization of an augmented volume functional which contains, via Lagrange multipliers, the governing equilibrium equations of the structure. In addition to the equilibrium condition, a strength capacity condition must be included in the formulation of the strength problem. This direct formulation yields a classical Lagrange problem in the variational calculus. The Euler–Lagrange equations of the augmented volume functional together with the governing equations define the minimum weight design of the structure. It is shown that the optimum design structure has constant maximum specific strain energy at every point in its given skeletal domain. Dissert. Abstr.

N69-21970 Massachusetts Univ., Amherst.
DYNAMIC RESPONSE OF ELASTICALLY CONNECTED THIN PLATES
Paul Xavier Bellini (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-14581

The dynamic response of a system of elastically connected thin plates is presented. The plates assumed to be similar in geometry, mass, and elastic properties are subjected to time-varying surface loadings. With these restrictions a set of N coupled partial

differential equations of motion for rectangular and circular plates is formulated for both isotropic and anisotropic conditions. General solutions for free and forced vibrations are developed. In particular, the dynamic response of a two plate system consisting of cylindrically aeolotropic circular plates is determined for both like and unlike boundary conditions. The response of a two plate simply supported system subjected to a step function loading is found with the use of an electronic computer. From this analysis, the response of a single cylindrically aeolotropic plate with and without an elastic foundation is determined. Dissert. Abstr.

N69-21998 Stanford Univ., Calif.
EXTERNAL CRACK PROPAGATION (CLEAVAGE) IN A CONTINUUM MODEL WITH NONLINEAR ATOMIC SEPARATION LAWS
Jerry Max Anderson (Ph.D. Thesis) 1968 120 p
Avail: Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-11264

The problem of a linear elastic solid containing two coplanar external cracks is considered. The distribution of stress in the solid when forces are applied to the crack faces is obtained. Griffith criteria are developed for the extension of the cracks under several principal cases of loading. For application to ductile materials, plastic deformation in the vicinity of the crack tips is investigated on the basis of Dugdale's hypotheses. The Goodier-Kanninen model is used to determine the distribution of cohesive forces near the crack tips for four nonlinear atomic force-separation laws. The results suggest that the distribution is the same for most mobile equilibrium cracks and thus lends support to Barenblatt's hypothesis. The extension criterion obtained with the Goodier-Kanninen model is compared with that of the Griffith theory. Dissert. Abstr.

N69-21999 Wisconsin Univ., Madison.
STRESSES AND DISPLACEMENTS IN CROSS-ANISOTROPIC, LAYERED, ELASTIC HALF-SPACE DUE TO AXI-SYMMETRIC LOADINGS ON THE TOP SURFACE
Rathindra Kumar Bhattacharyya (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-9056

An analysis is made of the stresses and displacements induced by axi-symmetric loadings at the surface of a layered elastic solid consisting of homogeneous, cross-anisotropic, plane layers bonded to one another thus forming a semi-infinite space. The method of solving a general n-layer system is presented. Numerical solutions are carried out for a point load acting on the following two kinds of elastic half-space: (1) two-layer system; (2) single-layer system, i.e., when the elastic half-space is homogeneous. The solution is based on solving the differential equations of equilibrium in terms of displacements. Formulation of the problem is obtained by writing Fourier integral expressions for the radial and vertical displacements. Numerical results are computed for a point load acting vertically downwards on the top horizontal surface. However, the stresses and displacements due to any kind of loaded area at the top surface can be determined by superposing the results of the problem of a point load. It is found that for the homogeneous, elastic half-space with a point load at the top surface the infinite integrals appearing in the expressions of the stresses and displacements can have closed form solutions which are used in the computations. For the two-layer system these infinite integrals are evaluated numerically by Simpson's rule... Dissert. Abstr.

N69-22000 Case Western Reserve Univ., Cleveland, Ohio.
DESIGN ORIENTED ANALYSIS AND SYNTHESIS OF MULTILAYERED-FILAMENTARY STRUCTURAL PANELS
Chintoo C. Chamis (Ph.D. Thesis) 1967 466 p
Avail: Univ. Microfilms: HC $21.15/Microfilm $5.85 Order No. 68-10146

A semiempirical theory is developed for composite structural behavior analysis. In this theory, both filaments and matrix are treated as generally orthotropic and the effects of voids are considered. Structural synthesis principles are applied successfully to the optimization of a multilayered-filamentary composite structural panel. The application of structural synthesis principles is extended to sensitivity analyses. These analyses are employed in the study of the sensitivity of optimum designs to critical preassigned parameters, empirical factors, and perturbations of applied loads. The theory correlates well with available experimental results; it is easily amenable to design practice and it is efficient for embodiment in structural synthesis capabilities. The optimum design results of several cases of carbon filament resin matrix composites are presented to demonstrate the application of synthesis principles to these materials. The results of the sensitivity analysis on these composites show that the optimum designs are sensitive to matrix properties, to interply layer effects and to applied loads. The results of the sensitivity analysis are subsequently utilized to select design variables for more general structural synthesis formulations. Dissert. Abstr.

N69-22020 Texas A&M Univ., College Station.
A SECOND-APPROXIMATION THEORY FOR SANDWICH SHELLS
Rufus Edward Martin (Ph.D. Thesis) 1968 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-11468

Equations are developed, based on second approximation shell theory, which describe the behavior of sandwich shells. The equations are obtained by assuming the stresses in the core material acting in the tangential directions are negligible compared to stresses acting in the transverse direction. Thus the core material carries only transverse shear stresses and transverse normal stresses. With this assumption, together with the expressions for the strain components, the equilibrium equations, and the stress-strain relations for the orthotropic core, expressions for the displacement variations through the core thickness are obtained. These expressions for displacement components contain unknown functions of integration which are solved by establishing displacement and stress continuity relations at core facing interfaces. Dissert. Abstr.

N69-22035 Texas Univ., Austin.
AN ELASTIC INSTABILITY ANALYSIS OF ORTHOTROPIC OGIVAL SHELLS OF REVOLUTION SUBJECTED TO STATIC AXISYMMETRIC EXTERNAL PRESSURES
Thomas Glynn Priddy (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-10881

An energy formulation is presented for the elastic stability problem of thin orthotropic shells of revolution subjected to static axisymmetric loading. Approximate solutions are explored for an ogival shell under external pressure loading. A systematic numerical analysis procedure is utilized to accommodate the complicated construction details and to permit various refinements in meridional buckle mode shapes. Two types of assumed edge support, simply supported and fixed, are studied. Routines are included for an analysis of filament wound ogive construction. Published results for limiting shapes of ogives are compared with the numerical results obtained in the present study. Curves which illustrate these comparisons, effects of the special geometry, and effects of construction details are presented. Dissert. Abstr.

N69-22063 Wisconsin Univ., Madison.
VIBRATIONS OF SPACE FRAMED STRUCTURES

Charles Chia-Le Lee (Ph.D. Thesis) 1968 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-9094

Free and forced vibrations of space structures which contain slender members are investigated. For each member, longitudinal, torsional, and bending vibrations are considered. The effects of rotatory inertia and shear deformation in bending vibrations are brought into consideration. Two types of coordinate systems are used, system coordinates and member coordinates. The dynamical slope deflection method is used to derive the equations of equilibrium and the natural frequency determinant in system coordinates. An orthogonality relation between two modes of a vibrating structure is found and proved. The applications of orthogonality for solving initial value and forced vibration problems by using series expansion methods in normal modes are studied.
Dissert. Abstr.

N69-22076 Colorado Univ., Boulder.
THE BUCKLING OF COMPLETE SPHERICAL SHELLS SUBJECTED TO A UNIFORM EXTERNAL PRESSURE
John Joseph Burns, Jr. (Ph.D. Thesis) 1968 221 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-14222

The problem of the buckling of a complete isotropic spherical shell subjected to a uniform external pressure is discussed. The critical buckling pressure of the shell and the post buckling shell deformation, as a function of the applied surface pressure, are considered. The critical buckling pressure is found from stability equations developed from equilibrium conditions on a deformed element of the shell. Buckling pressures are determined for symmetric and asymmetric buckling modes. Elastic axisymmetric post buckling shell displacement is investigated. Post buckling equilibrium equations are developed using the theory of minimum total potential energy and Euler equations.
Dissert. Abstr.

N69-22080 Oregon State Univ., Eugene.
DYNAMIC RESPONSE OF STEEL STRUCTURES WITH SEMIRIGID CONNECTIONS
Joseph Edward Grant (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-14478

The nonlinear response of a ten-story steel structure with semirigid girder connections is studied under conditions of dynamic loading. The dynamic loading used in this study is the north-south component of the May 18, 1940, El Centro, California earthquake. The structure is idealized by a series of equivalent masses, lumped at the floor levels and restrained by weightless members. The physical model used to represent individual members consists of a flexible central beam with springs attached at both ends. All connections have the capability of exhibiting bilinear hysteresis curves. A numerical procedure is used to integrate the governing differential equations. The nonlinear response is obtained as a sequence of linear responses of successively differing systems.
Dissert. Abstr.

N69-22081 Case Western Reserve Univ., Cleveland, Ohio.
STRUCTURAL SYNTHESIS OF A STIFFENED CYLINDER
William Moore Morrow, II (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-10172

The problem of structural synthesis of a cylindrical shell stiffened in the longitudinal and circumferential directions with rectangular cross-section stiffeners is treated. The stability analysis of the cylinder is a linear analysis including the effects of eccentricity. The synthesis method uses the penalty function method of Fiacco and McCormick. The design variables are the dimensions and spacings of the stiffeners and the thickness of the skin, seven in all. Numerical results are presented which demonstrate the capability of the method and some properties of the design space both for single and multiple load condition problems.
Dissert. Abstr.

N69-22129 Arizona Univ., Tucson.
A METHOD FOR ANALYZING NONLINEAR PLATE STRUCTURES
Jimmy Hiram Smith (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-13672

A method for analyzing structural plates which possess nonlinear material properties is developed and presented. A numerical technique is suggested where the continuous plate is replaced by interconnected elements which are assigned properties that approximate the actual behavior of the plate. A mathematical model is developed which represents the nonlinear action desired. The success of the beam model is made possible by approaching the problem from a differential point of view coupled with a three parameter moment rotation equation. The solutions are then obtained using a fourth order Runge-Kutta integration technique. All solutions were obtained with the aid of a digital computer program which was developed for this investigation.
Dissert. Abstr.

N69-22153# Norwegian Inst. of Tech., Trondheim.
ANALYSIS OF SPHERICALLY AND CYLINDRICALLY DIVERGENT STRESS PULSES IN LINEAR VISCOELASTIC SOLIDS
Sigurd Stoeren 1968 44 p refs *Its* Acta Polytech. Scand., Phys. Nucl. Ser. 55
(PR-180622; APS-PH-55) Avail: CFSTI CSCL 20K

Four different linear viscoelastic models, namely the Standard Linear Solid, the generalized Maxwell Solid, the Constant Loss Tangent Solid and Kelvin-Voigt Solid are analyzed. The dilatational wave velocity and attenuation coefficient for the different models are compared. Fourier analysis is applied to the divergent stress pulse problem in spherical and cylindrical geometries, and the effect of the different damping models on the propagating pulse is discussed. It is shown that the simple 'Constant loss tangent' model gives a pulse shape almost identical to that of the more realistic generalized Maxwell model. The choice of a particular model, however, is not very important in this problem, because the propagating pulse is carried by amplitudes in a very narrow frequency range.
Author (USGRDR)

N69-22193 Illinois Univ., Urbana.
ENVIRONMENTALLY ASSISTED FATIGUE CRACK GROWTH RATES IN SAE 4340 STEEL
Joseph Patrick Gallagher (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-12125

Crack growth rates resulting from static and tension-tension fatigue loadings were studied for SAE 4340 steel in a distilled water environment at ambient temperature. For the fatigue loads in this investigation, the frequency was one cycle a second. The crack growth rates resulting from the small amplitude tension-tension fatigue loads were predominantly time dependent. These crack growth rates did not significantly differ from the corresponding static crack growth rates when the rates were compared statistically for static and fatigue mean stress intensity levels. The large load amplitude tension-tension fatigue crack growth rates were found to be 30 to 40 per cent lower than the static rates when compared using the same basis.
Dissert. Abstr.

N69-22224 California Univ., Berkeley.
A STUDY OF THE COMPLIANCE RELATIONSHIPS AND ENERGY DISSIPATION IN A CENTRALLY LOADED AXISYMMETRICAL GRANULAR ARRAY
Dale Charles Perry (Ph.D. Thesis) 1968 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-13947

A study is made of the behavior of a centrally loaded granular assemblage consisting of two like elastic spheres in near contact but restrained by a radial ring of elastic spheres symmetrically arranged about the loading axis passing through the centers of the primary spheres. The radii and elastic properties of the radial spheres are permitted to vary relative to the primary set. Based upon considerations of the elastic and inelastic deformations at the points of contiguity of the spheres and/or rigid body displacements due to gross slippage, total (as compared to incremental) axial and radial load response relations are derived. A single cycle of loading and unloading is considered in order to evaluate the magnitude of energy dissipated due to friction at the surfaces of contact of the dissimilar spheres. Dissert. Abstr.

N69-22276# Chalmers Univ. of Technology, Goteborg (Sweden).
THERMALLY LOADED ELASTIC BEAMS AND PLATES ANALYZED BY DISPLACEMENT METHOD IN DIFFERENTIAL FORM
Bengt A. Akesson 1968 35 p refs *Its* Acta Polytech. Scand., Civil Eng. Bld. Construct. Ser. 50
(PB-180627; APS-CI-50) Avail: CFSTI CSCL 13M

Displacement method solutions in differential form are formulated for thermally loaded linearly elastic beams and plates whose lateral deflections obey the Euler-Bernoulli-Navier and Germain-Lagrange-Kirchhoff differential equations. Deflections and section moments caused by temperature gradient load are calculated. The classical analysis of beams and plates by differential and integral calculus is linked to the modern analysis by matrices. The proposed way of looking at the classical analysis and the unifying terminology suggested are intended to promote clarity and understanding of the subject matter, and thereby facilitate systematic and correct computations. No fundamentally new solutions are given. Author (USGRDR)

N69-22278# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
A LINEARIZED LARGE DEFORMATION, ANALYSIS FOR SHALLOW AXISYMMETRIC MEMBRANES Interim Report
Martin A. Goldberg Dec. 1968 51 p refs
(Contract AF 49(638)-1360)
(AD-681507; AFOSR-68-2812; PIBAL-68-37) Avail: CFSTI CSCL 20/11

Analysis of the nonlinear behavior of lightly loaded, initially curved, axisymmetric membrane shells where the nonlinearity is associated with either highly localized loads or points of attachment is investigated. The large deformation analysis is facilitated by employing a linearized representation of the original nonlinear equations. Thus, the governing equation is characterized by a second order ordinary linear differential equation with variable coefficients. The order of this equation is sufficient to permit satisfaction of physically realizable boundary conditions. Specific problems associated with technically important structural shapes have been examined in detail. These include the shallow spherical shell, complete cone, and a shallow toroidal cap. Only axisymmetric loadings have been considered, these being either a uniform internal pressure, a concentrated load applied to a pole or apex, or a combination of the two loads. Author (TAB)

N69-22310# Texas Univ., Austin. Center for Highway Research.
AN INDIRECT TENSILE TEST FOR STABILIZED MATERIALS. EVALUATION OF TENSILE PROPERTIES OF SUBBASES FOR USE IN NEW RIGID PAVEMENT DESIGN
W. Ronald Hudson and Thomas W. Kennedy Jan. 1968 88 p refs
(PB-180723; RR-98-1) Avail: CFSTI CSCL 13M

The authors state that direct tensile tests present serious difficulties in gripping the test specimen and in eliminating eccentricity of loading. Presented is an alternate method to measure tensile properties of granular-stabilized materials. In this test method, a cylindrical specimen is strip-loaded in compression along its longitudinal axis. Five factors affecting the test results are discussed in the report with supporting data included. Testing apparatus and test conditions are recommended on the basis of the study. USGRDR

N69-22312# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
THE LINEARIZATION OF THE PREBUCKLING STATE AND ITS EFFECT ON THE DETERMINED INSTABILITY LOADS
Arnold D. Kerr and Martin T. Soifer Sep. 1968 40 p refs
(Grant AF-AFOSR-67-0813)
(AD-681505; NYU-AA-68-37; AFOSR-68-1921) Avail: CFSTI CSCL 13/13

The effect of the linearization of the prebuckled state upon the determined buckling loads is studied first on an elastic system of two degrees of freedom and then on a shallow arch subjected to a uniform lateral load; structures that exhibit a non-trivial state of stress, an upper buckling load, a lower buckling load, and a bifurcation load. For each case the exact solution of the nonlinear formulation is discussed first. Then, using the perturbation analysis, the instability loads are determined again using, respectively, the exact and the linearized prebuckled state. The paper concludes with a comparison of the obtained buckling loads and a discussion of relevant problems. It was found that the usual 'adjacent equilibrium' argument presented in the literature, according to which only the displacements are perturbed, is not applicable for the determination of the bifurcation pressures of the shallow arch. A proper argument is presented and then used to determine the bifurcation and limit points. Author (TAB)

N69-22403# General Dynamics/Astronautics, San Diego, Calif.
VIBRATION AND FLUTTER OF THIN PRESSURIZED SHELLS IN SUPERSONIC FLOW
Ta Li 1969 61 p refs
(AD-682139) Avail: Issuing Activity CSCL 13/13

This report concerns the vibration and flutter of a thin pressurized shell. It consists of the following three parts: Free vibration in vacuo; Vibration in supersonic flow; and Supersonic flutter. Both structural and aerodynamical boundary conditions are taken into consideration. Author (TAB)

N69-22414# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugzeugbau.
ANALYSIS OF INITIAL IMPERFECTIONS OF CIRCULAR CYLINDERS [ANALYSE DER VORBEULFORM VON WIRKLICHEN KREISZYLINDERN]
M. Esslinger Oct. 1968 40 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-69) Avail: CFSTI

It has been shown how a measurement of the initial imperfections of a thinwalled circular cylinder was obtained, how the pattern was expanded into a double Fourier series and, finally, how a small number of terms of this series was selected in order to study their influence on the results of the stability investigations. Author (ESRO)

N69-22439# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugzeugbau.
A METHOD FOR THE THEORETICAL INVESTIGATION OF THE BUCKLING AND POSTBUCKLING BEHAVIOUR OF THIN-WALLED CIRCULAR CYLINDERS WITH CLAMPED EDGES [EIN VERFAHREN ZUR THEORETISCHEN UNTERSUCHUNG DES BEUL- UND NACHBEULVERHALTENS DUNNWANDIGER KREISZLINDER MIT EINGESPANNTEN RAENDERN]
Maria Esslinger Dec. 1968 127 p refs In GERMAN; ENGLISH Summary
(DLR-FB-68-70) Avail: CFSTI

A method of calculation for the states of equilibrium in the pre- and postbuckling region of thinwalled axisymmetrically loaded circular cylinders with clamped edges was derived. The cylinders are allowed to have initial imperfections, whereby the edges also deviate from the ideal shape. The stability of the calculated states of equilibrium is investigated. Further, the variation of the radial deformations and the stresses over the surface of the cylinder is presented and the potential energy for each equilibrium state is evaluated. Author

N69-22451# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugzeugbau.
CALCULATION OF BUCKLING LOAD OF PERFECT AXISYMMETRIC LOADED, THINWALLED CIRCULAR CYLINDERS WITH CLAMPED EDGES [BEULLASTBERECHNUNG FUER IDEALE AXIALSYMMETRISCH BELASTETE, DUENNWANDIGE KREISZYLINDER MIT EINGESPANNTEN RAENDERN]
M. Esslinger Oct. 1968 51 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-68) Avail: CFSTI

A simple iteration procedure has been developed for the calculation of the critical load of thinwalled circular cylinders with clamped edges. The numerical results obtained for a longitudinally stiffened cylinder under axial compression are discussed. Author (ESRO)

N69-22520# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
STRESS ANALYSIS PROGRAM SUMMARY FOR BORON COMPOSITE FB-111 WING BOX EXTENSION
D. Weingart Jul. 1968 45 p refs
(FSR-AD2-01-68.7) Avail: Issuing Activity

This report presents a stress analysis summary for the FB-111 Boron Composite Wing Tip. Contained in the report are the idealized loads and geometry used for the Finite Element Analysis of beam, rib and cover loads, and a list of critical margins of safety. The method used to design and analyze the boron composite laminates is also presented in the report. The results of this stress analysis indicate that the FB-111 boron-epoxy wing tip structure has satisfactory strength. The B-1, forward CP loading condition is critical, resulting in margins of safety of 0.05 at the root in the upper cover and 0.08 at the root in the lower cover access door. The results of this analysis will be confirmed by static and fatigue test of the component. Author

N69-22575*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF SPACE VEHICLE STRUCTURES USING THE TRANSFER-FUNCTION CONCEPT
E. Heer and M. R. Trubert 1 Apr. 1969 19 p refs
(Contract NAS7-100)
(NASA-CR-100608, JPL-TR-32-1367) Avail: CFSTI CSCL 20K

The concept of frequency transfer function is used for the analysis of space vehicle structures. The method of determining the dynamic response of a structural system from the subsystems characteristics is reviewed and explored for applications to space vehicle systems. The basic problem is considered to be that of joining together and determining the dynamic response of a number of subsystems that may be excited by deterministic and/or stationary random multiple inputs. The subsystems may represent, for instance, a launch vehicle, a spacecraft, an entry capsule, and a lander system; or they may represent a structure under test and a system of shakers that substantially influence the experimental results during dynamic testing, the effects of which are to be eliminated so that the true transfer functions can be obtained. The specific objectives of this paper are to present a unifying and general picture of the transfer-function technique and to illustrate with a number of examples its practical utility in actual life situations as they have been encountered at the Jet Propulsion Laboratory. Author

N69-22773# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NATURAL VIBRATION MODAL ANALYSIS
J. S. Archer (TRW Systems) Sep. 1968 35 p refs
(NASA-SP-8012) Avail: CFSTI CSCL 20K

Resulting from the need for uniform criteria in space vehicle design, a discussion is presented on the state of the art, basic criteria, and recommended practices for obtaining natural vibration modal data and its subsequent analysis. The results of such analyses provide a description of the linear dynamic characteristics of the space vehicle structure and are basic to understanding the dynamic transient accelerations, velocities, and displacements experienced by the vehicle under any kind of excitation. A.C.R.

N69-22821*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SHALLOW MERIDIONAL CURVATURE ON THE VIBRATION OF NEARLY CYLINDRICAL SHELLS
Paul A. Cooper Washington Apr. 1969 41 p refs
(NASA-TN-D-5143) Avail: CFSTI CSCL 20K

Curvature effects on minimum natural frequencies of nearly cylindrical shells with either positive or negative Gaussian curvature were investigated. The positive Gaussian curvature shells have minimum natural frequencies well above those of corresponding cylindrical shells. The minimum natural frequencies of the negative Gaussian curvature shells generally are below those of the corresponding cylinders, and evidence wide variations in value and large reductions in magnitude occurring at certain critical values of curvature. The large reductions in magnitude result from a condition of essentially inextensional vibration. It is shown that membrane theory affords a simple method of determining the modal wavelength ratio and curvature combinations at which these reductions occur, whereas pure bending theory gives a good estimate of the magnitudes of the associated frequencies. Author

N69-22823*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS-RUPTURE AND TENSILE PROPERTIES OF REFRACTORY-METAL WIRES AT 2000° AND 2200°F (1093° AND 1204°C)
Donald W. Petrasek and Robert A. Signorelli Washington Apr. 1969 41 p refs
(NASA-TN-D-5139) Avail: CFSTI CSCL 20K

Tungsten, molybdenum, and columbium base alloy wire were tested at room temperature, 2000°F (1093°C) and 2200°F (1204°C). Metallographic examinations were also made of the wire microstructure after testing. Ultimate tensile strength values of up to 240,000 psi for W - 5% Re - 2% ThO_2 wire tested at

2000°F and up to 160,000 psi for W – 3% Re wire tested at 2200°F were obtained. The best strength values obtained for a 100 hour rupture life were 96,000 psi at 2000°F and 69,000 psi at 2200°F for W – 2% ThO_2 wire. These properties suggested that the wires showed promise as potential fiber reinforcements in the 2000° to 2200°F temperature range. Author

N69-22828# Advisory Group for Aerospace Research and Development, Paris (France).
POSSIBLE EFFECTS OF SERVICE CHANGES IN COMPRESSION STRESS-STRAIN CURVES ON BUCKLING
W. Barrois (Serv. Tech. Aeron., Paris) Apr. 1968 20 p refs
(AGARD-564) Avail: CFSTI

In work-hardened engineering materials, the proportional limit stress in compression is seriously reduced after fatigue; consequently, the fatigue of structures gives rise to a lowering in strength of the compressed parts. In order to draw attention to this fact, a short review and some numerical calculations are made on problems of buckling in the plastic range with initial eccentricities which are possibly modified by creep and show fatigue changes in plastic properties. Author

N69-22872# British Steel Corp., London (England). Plant Engineering and Energy Div.
TESTS ON LATERALLY UNSUPPORTED BEAMS OF STEEL B.S. 15 Bisra Open Report
J. E. Dibley and J. S. Sowter 13 Oct. 1967 17 p refs
(PB-180445; PE/E/31/67) Avail: CFSTI CSCL 13M

Two tests were carried out to determine experimentally the effective length factor of a beam restrained laterally by typical structural connections. A comparison is made of the lateral restraint stiffness applied to the test beam, theoretical estimates of the required stiffness and that recommended in the British Standard Codes of Practice. It is concluded that tests should be carried out to determine the effective length factors for beams and columns with typical structural connections. Author (USGRDR)

N69-22932*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LONGITUDINAL VIBRATION CHARACTERISTICS OF 1/10-SCALE APOLLO/SATURN 5 REPLICA MODEL
Larry D. Pinson and H. Wayne Leonard Washington Apr. 1969 82 p refs
(NASA-TN-D-5159) Avail: CFSTI 20L

A lumped parameter analysis was employed to assess the applicability of such an analysis to a complex Saturn V type of launch vehicle and to investigate the effects of tank orthotropy and the method of representing the mass of contained liquids on the calculated natural modes and frequencies of the system. An approximate theory which accounts for tank wall orthotropy is developed for the calculation of springs associated with liquid tank systems. A simple analysis is presented which shows that the actual value of the mass of the contained liquid may not be the correct value for incorporation into a lumped parameter analysis. Model test results are presented for first stage propellant loading conditions corresponding to several time points during first stage burn. The experiment and analysis show generally good correlation in both frequency and deflection shape for structural modes; however, discrepancies are found when the system responds in either propellant modes or in coupled structural propellant modes. Also, use of an analytical equivalent liquid mass value for contained liquids produces better agreement with experiment for the liquid tank modes whereas actual liquid mass values produced better agreement for structural modes. Author

N69-22943# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
MOVING LOAD ON A VISCOELASTIC LAYERED SYSTEM
F. Moavenzadeh and J. F. Elliott Jun. 1968 189 p refs
(Contract FH-11-6619)
(PB-180709; R68-37) Avail: CFSTI CSCL 13M

A solution technique is developed and presented for the investigation of the stresses and displacements induced in a three layer viscoelastic system that is subjected to uniformly distributed normal loads. In this investigation, two different cases are considered: (1) A steady localized load is made to move at a constant velocity in a straight line on the initially flat surface of a three layer system. (2) The rest of the investigation is concerned with the response of the system to a load that is repeatedly applied to the same region on the surface at a specified frequency. Author (USGRDR)

N69-22982*# General Technology Corp., Lawrenceville, N. J.
A LATTICE MODEL FOR COMPOSITE MATERIALS
T. R. Tauchert, T. Y. Chang, and A. C. Eringen Washington NASA Apr. 1969 24 p refs
(Contract NASw-1589)
(NASA-CR-1322; TR-8-8) Avail: CFSTI CSCL 20K

A lattice theory is developed for composite materials in which the matrix and inclusions of the composite are idealized as a gridwork of thermoelastic bars attached to small rigid masses. This model generalizes the spring and mass model prominent in the classical lattice theory of solids. Replacement of the springs by elastic bars provides extra internal degrees of freedom beyond the central force model of the lattice theory. The lattice representation leads to a system of finite difference equations of motion which can be used to solve dynamic and thermal stress problems numerically. Equations for stress and couple stress are obtained, which are identical in form to those of the linear theory of micropolar thermoelasticity. Author

N69-22983*# Drexel Inst. of Tech., Philadelphia, Pa.
MCDIT 21: A COMPUTER CODE FOR ONE-DIMENSIONAL ELASTIC WAVE PROBLEMS
Richard W. Mortimer and James F. Hoburg Washington NASA Apr. 1969 33 p refs
(Grant NGR-39-004-13)
(NASA-CR-1306; Rept-340-2) Avail: CFSTI CSCL 20K

The code involves the application of the method of characteristics to the displacement governing differential equations of motion of the structures. Some of the structures which can be analyzed by this program include shells, Mindlin plates, bars, and Timoshenko beams; subroutines for these structures have been prewritten for the user. The code is capable of handling boundary conditions which may be specified as step, ramp, exponential, and sinusoidal time functions; these have also been prewritten for the user. Detailed instructions for the use of the program, its computational procedure, and its limitations are given. An example involving the impacting of a conical shell is included. Author

N69-22984*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRATER CHARACTERISTICS OF 11 METAL ALLOYS UNDER HYPER-VELOCITY IMPACT INCLUDING EFFECTS OF PROJECTILE DENSITY AND TARGET TEMPERATURE
Nestor Clough, Seymour Lieblein, and A. R. McMillan (General Motors Corp., Santa Barbara, Calif.) Washington Apr. 1969 28 p refs
(NASA-TN-D-5136) Avail: CFSTI CSCL 20K

Spherical Pyrex, aluminum, steel, nylon, and Inlyte projectiles were accelerated to velocities from 4.88 to 8.35 kilometers per second and impacted against thick flat plate targets at room and elevated temperatures. Targets impacted were aluminum alloys 2024-T6, 7075-T6, and 356-T51; columbium – 1 percent zirconium; tantalum; vanadium; molybdenum–TZM, A-286; Inconel–718; 316 stainless steel; and L-605. Correlations were determined for the effects of projectile density and target temperature on the cratering characteristics of these materials. Author

N69-23096*# Measurement Analysis Corp., Los Angeles, Calif.
SUMMARY OF RANDOM VIBRATION PREDICTION PROCEDURES
R. L. Barnoski, A. G. Piersol, W. F. Van Der Laan, P. H. White and E. F. Winter Washington NASA Apr. 1969 147 p refs
(Contract NASB-20020)
(NASA-CR-1302) Avail: CFSTI CSCL 20K

Various procedures suggested in recent years for the prediction of random vibration environments in modern flight vehicles are summarized and discussed. A total of fifteen individual techniques are included. The basic principles of the procedures are outlined, and known experiences in their use are reviewed. Special attention is given to the assumptions inherent in their use as well as the information required for their application. The relative advantages and limitations of the procedures are detailed. Author

N69-23197# Lockheed Missile and Space Co., Palo Alto, Calif.
ON THE DEPENDENCE OF ERRORS IN SHELL THEORY EQUATIONS (IN THE VARIOUS VERSIONS) ON THE INDEX OF VARIABILITY OF THE STRESS STATE
L. I. Liotko 8 May 1968 6 p refs Transl. into ENGLISH from Inzh. Zh. Tverdogo Tela (USSR), no. 5, 1968 p 162–166
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The established solution to elasticity theory equations for a closed spherical shell under arbitrary surface load distribution is compared with other approaches to the problem, by starting with different versions of shell theory approximation. The calculations were made in order to clarify the index of variability influence of the stress state on Love-Kirchhoff error assumptions. A zero (uniform load distribution) to 1/2 range in the index of variability is investigated, and the error in the initial assumptions of shell theory as a function of this index is written as a simple formula. A.C.R.

N69-23208# Lockheed Missiles and Space Co., Palo Alto, Calif.
INTERACTION OF A REINFORCED CYLINDRICAL SHELL WITH AN ACOUSTIC WAVE
V. L. Proskin [1968] 5 p refs Transl. into ENGLISH from the book "Theory of Plates and Shells" Kiev, AN UkrSSR, v. 2, 1962 p 305–308
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The motion of an infinite cylindrical shell subjected to an acoustic wave is considered. The shell is reinforced at equal intervals by absolutely stiff ribs in their plane. From the symmetry of the shell motion in each compartment between the ribs, it follows that the boundary conditions for a shell compartment in a coordinate system connected with the ribs are conditions for fixing the endfaces of the compartment. The solution of the problem of interaction between a reinforced cylindrical shell and an acoustic wave reduces to the solution of a system of ordinary differential equations with zero initial values of the functions. Author

N69-23243# Lockheed Missile and Space Co., Palo Alto, Calif.
ANALYSIS OF A VERY LONG RING-REINFORCED CYLINDRICAL SHELL
L. A. Roiak 1968 4 p ref Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (USSR), no. 3, 1968 p 158–160
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A solution is proposed for determining the radial displacement of the shell when concentrated radial force loading is applied to the ring. Using the method of superposition, formulas and tables are derived from which the effect of one concentrated force may be obtained without the zero and first members of the Fourier series expansion, and it is noted that analogous formulas and tables can be compiled to calculate radial displacement under the effect of tangential concentrated forces. A.C.R.

N69-23268# British Steel Corp., London (England). Metallurgy Div.
COMPLIANCE FUNCTIONS FOR VARIOUS TYPES OF TEST SPECIMEN GEOMETRY
E. F. Walker and M. J. May 1968 18 p refs
(PB-180453; MG/E/307/67) Avail: CFSTI CSCL 20K

A review is made of the calculation procedures for determining the plane strain fracture toughness from the specimen geometry and applied load. The compliance functions used in such calculations are complex and in order to simplify calculation of K sub 1 values the compliance functions have been expressed in tabular form for seven of the more popular types of fracture toughness specimen. Author (USGRDR)

N69-23302# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF ELASTIC SYSTEMS SUBJECTED TO RANDOM LOADS
B. G. Lezhnev [1968] 9 p refs Transl. into ENGLISH from Issled. po Teorii Sooruzh. (USSR), no. 16, 1968 p 81–87
Presented at 4th All-Union Conf. on Strength and Plasticity, 3 Feb. 1967
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A mathematical discussion is presented on elastic systems and individual elements subjected to loading such as earthquakes or violent explosions. It is assumed that the internal friction is independent of the damping from strain rate. The results are compared with those using a viscous friction hypothesis. N.E.N.

N69-23320*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BUCKLING OF THIN-WALLED CIRCULAR CYLINDERS
V. I. Weingarten (Univ. of Southern Calif.), P. Seide (Univ. of Southern Calif.), and J. P. Peterson Aug. 1968 58 p refs Revised
(NASA-SP-8007) Avail: CFSTI CSCL 20K

Current practices for predicting buckling of uniform stiffened and unstiffened circular cylindrical shells under various types of static loading, and suggested procedures that yield estimates of static buckling loads are presented. Details are given on recommended practices for isotropic unstiffened cylinders, orthotropic cylinders, isotropic sandwich cylinders, and cylinders with an elastic core. These discussions include axial compression, bending, external or lateral pressure, torsion, and combined loads. The important problems and the limitations of the procedures are indicated. N.E.N.

N69-23326# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Statik und Stahlbau.
A CONCEPT OF FATIGUE MECHANISM BASED ON LOCAL STRAIN AND FRACTURE PROCESSES WITH APPLICATION TO NOTCHED AND UNNOTCHED SPECIMENS AND STATICALLY INDETERMINATE SYSTEMS AND WITH CONSIDERATION OF VARIABLE NOTCH RADII, RESIDUAL STRESSES, AND CORROSION INFLUENCE [EIN KONZEPT FUER DEN DAUERBRUCHMECHANISMUS AUF DES

GRUNDLAGE OERTLICHER BEANSPRUCHUNGS- UND BRUCHVORGAENGE: ANWENDUNG AUF GEKERBTE UND UNGEKERBTE PROBEN UND STATISCH UNBESTIMMTE SYSTEME UNTER BERUECKSICHTIGUNG VON KERBAENDERUNGEN, EIGENSPANNUNGEN UND KORROSIONSEINFLUESSEN]

K. Kloeppel and T. Seeger 1968 119 p refs In GERMAN; ENGLISH summary
(Rept-4) Avail: CFSTI

A concept for the fracture mechanism in fatigue loaded notched and unnotched specimens is developed. The Manson–Goffin law for the fracture or crack propagation rate is used as fracture criterion for a volume element. The differential equation of fracture or crack propagation rate in notched specimens is used for the calculation of the total strain range in the notch root by means of the strain concentration factor. A comparison is given between theory and test results of the special case of transversely slotted flat plate specimens with consideration of notch residual stresses and the increase of notch radius. Residual stresses due to temperature influence in the equation of crack propagation rate are compared with test results. Crack propagation in statically indeterminate systems in the case of a simple continuous beam is investigated, and corrosion influences in the equation of the crack propagation rate are examined. B.G.D.

N69-23342# Lockheed Missiles and Space Co., Palo Alto, Calif.
LOCAL STABILITY OF ELASTIC SHELLS OF REVOLUTION

E. I. Grigoliuk et al [1968] 6 p refs Transl. into ENGLISH from Inzh. Zh., Mekh. Tverdogo Tela (Moscow), no. 6, 1968 p 134–138
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

Bifurcation of the equilibrium mode of thin elastic shells is considered. Assuming a local character for the buckling process during the change in equilibrium mode, the stability equations are transformed, with the principal terms in the derivatives of the desired functions being extracted. These equations are represented in finite differences, and the solution of the stability problem is reduced, based on the transfer matrix, to seeking the roots of a characteristic equation whose form depends on the boundary conditions assumed for the problem. Numerical results are presented for an arbitrary shell of revolution subjected to external pressure. A.C.R.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also 12 Fluid Mechanics; and 27 Propellants.

N69-22032 Denver Univ., Colo.
AN INVESTIGATION OF THE EFFECT OF TEMPERATURE INDUCED SURFACE TENSION GRADIENTS ON BUBBLE MECHANICS AND BOILING HEAT TRANSFER

Jay Lininger McGrew (Ph.D. Thesis) 1968 104 p Supported in part by NASA
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-13708

As part of a study on fluid behavior in a zero gravity environment, an analysis was made which predicts that a net external force will result from the surface tension gradient and tend to push the bubble in a direction of increasing temperature. A useful dimensionless force parameter equivalent to the ratio of surface tension gradient force to buoyancy force is derived, and the liquid convection process resulting from surface tension gradients on a bubble surface is discussed. Experiments were conducted to verify the bubble force theory, and to examine in detail the influence of the surface tension gradient induced flow, the Marangoni effect, on the boiling mechanism. In the force experiment, the net force on a given deflecting cantilever wire was measured with and without surface tension gradients. The results of the experiments using various test liquids, bubble sizes, and temperature gradients agreed well with the theoretical prediction. Experiments were also conducted in which the heat transfer due to the Marangoni effect on bubble surfaces was measured. The heat transfer data obtained, as well as observations of liquid velocity and temperature patterns using optional techniques, showed that at low heat fluxes the Marangoni effect is very important as an additional mechanism for boiling heat transfer. It was concluded that the surface tension gradient effect is very important in bubble motion and the boiling phenomenon in zero-gravity. Dissert. Abstr.

N69-22114 University of Southern Calif., Los Angeles.
THERMAL CONDUCTIVITY OF LIQUIDS

George Martin Mellan (Ph.D. Thesis) 1968 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-13581

Experimental data as a function of temperature were collected, and two semiempirical correlations for the accurate prediction of this property for both polar as well as nonpolar liquids were developed. Experimental thermal conductivity data were obtained from a fast, transient response, hot-wire apparatus between temperatures of 60 and 250°F on 23 liquids: 4 nonpolar, 13 polar, and 6 complex petroleum mixtures. The precision of the experimental thermal conductivity data ranged from 1/2 to 2 percent, depending greatly upon the liquid's viscosity and its effect upon the onset of natural convection. In addition to the original data, values were compiled for 33 other liquids by restricting the search to a few experimentalists of recognized ability. Fairly reliable data were thus obtained on 56 liquids, forming a basis for the development of semiempirical correlations for the prediction of liquid thermal conductivities. The first, and most noteworthy, correlation deals with the linear temperature dependency of liquid thermal conductivities at ambient temperatures which has been shown previously to be valid for most nonpolar liquids. Investigations concerning the polar, associative and dielectric properties of these liquids led to a temperature dependency correlation which predicts thermal conductivity values at 277°F with an average error of 3.5 percent when experimental data at 77°F are used as the reference point. A second correlation was developed for use if reliable thermal conductivity data are not available at ambient temperatures and is shown to be valid for most nonpolar liquids if its use is restricted to ambient temperatures. Dissert. Abstr.

N69-22123 Case Western Reserve Univ., Cleveland, Ohio.
THE STRUCTURAL SYNTHESIS OF AN ABLATING THERMOSTRUCTURAL PANEL

William A. Thornton (Ph.D. Thesis) 1967 208 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-10190

The development of a structural synthesis capability for ablating thermostructural panels in a planetary entry environment is reported utilizing a penalty function technique in conjunction with integrated behavior constants. The thermal analysis included the effects of surface recession and pyrolysis gas transpiration. Dissert. Abstr.

N69-22138 Michigan Univ., Ann Arbor.
THERMAL CONDUCTIVITY OF POTASSIUM VAPOR

Dale Edward Briggs (Ph.D. Thesis) 1968 220 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-13283

A thorough review of all the techniques used to measure thermal conductivity of gases and vapors was made with particular attention to those methods suitable for high temperatures and corrosive vapors. A parallel plate cell with guard heated top plate was selected. Heat generated in the 2.01 inch diameter top plate by the top plate heater was transferred across a 0.0182 inch vapor space to the bottom plate. Molybdenum was selected for the cell material because of its corrosion resistance to potassium, low emissivity and high thermal conductivity. The thermal conductivity of nitrogen was measured with the cell to serve as a check on the cell and analysis procedure. The thermal conductivity of nitrogen thus measured for a temperature range of 900 to 1200°F was in excellent agreement (within 1 percent) with existing data. Dissert. Abstr.

N69-22154*# Michigan Univ., Ann Arbor. Gas Dynamics Labs.
TWO PHASE DETONATION AS RELATED TO ROCKET MOTOR COMBUSTION INSTABILITY Final Report
J. A. Nicholls Feb. 1969 26 p refs
(Contract NASr-54(07))
(NASA-CR-72532; UM-06324-6-F) Avail: CFSTI CSCL 20M

Research was directed at an investigation of the possibility and pertinence of detonations in liquid-gas systems (two phase or heterogeneous detonation) typical of liquid rocket motor operation. It soon became clear that two phase detonations were easily generated and that the aerodynamic shattering of the liquid drops played an important role in the mechanism. Also, it was found that the presence of a liquid film on the walls, without any droplets, was capable of supporting a similar two phase detonation. Attention has also been given to the study of the ignition of single fuel droplets behind strong shock waves and the attenuation of shocks and two phase detonations by acoustic liners. The work on the distribution of energy release behind the shock is not discussed separately but is covered under Spray Detonations. It also awaits further definition and understanding of drop ignition characteristics. Where possible, the various aspects of the problem are covered by reference to our past publications. Only that information not previously reported is presented in any detail. Author

N69-22167 Syracuse Univ., N. Y.
EXTENSIONS OF THE THEOREM OF CORRESPONDING STATES FOR THE THERMODYNAMIC PROPERTIES OF POLAR FLUIDS
Roland Lee Halm (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-13830

In this study, a fourth parameter x has been established to characterize the effects of polarity on the thermodynamic properties of polar fluids. The parameter x was defined as follows: $x = \log P_R - 1.552 - 1.7\omega$ ($T_R = 0.6$) where ω is the acentric factor defined previously for normal fluids as $\omega = -\log P_R - 1.0$ ($T_R = 0.7$). Series expansions were used to represent the dependence of reduced thermodynamic properties on ω and x. Experimental data were used to establish values of the polar correction terms for the reduced vapor pressure for $0.44 \leq T_R \leq 0.70$, the entropy of vaporization for $0.56 \leq T_R \leq 0.72$, the group P_cV/RT_c for saturated liquids for $0.58 \leq T_R \leq 1.00$, the compressibility factor of saturated vapors for $0.70 \leq T_R \leq 1.00$ and the second virial coefficient for $0.64 \leq T_R \leq 0.94$. Dissert. Abstr.

N69-22221*# National Bureau of Standards, Boulder, Colo.
THERMODYNAMIC PROPERTIES OF ARGON FROM THE TRIPLE POINT TO 300 K AT PRESSURES TO 1000 ATMOSPHERES
A. L. Grossman, R. D. McCarty, and J. G. Hust Mar. 1969 154 p refs
(NASA Order-R-06-006-046)
(NASA-CR-100532; NSRDS-NBS-27) Avail: SOD $1.25; CFSTI CSCL 20M

Tabular values of density, internal energy, enthalpy, and entropy of liquid and gaseous argon are presented for temperatures from 83.8 to 300 K at pressures of 0.01 to 1000 atmospheres. Diagrams of specific heats, compressibility factor, and entropy are included. The properties presented are calculated from an equation of state which was fitted to experimental P–ρ–T data from the world literature. Extensive comparisons were made between the equation of state and the experimental data, and deviation plots are presented. The second virial coefficient and Joule–Thomson inversion curve were also calculated and comparisons made with values from other sources. A vapor pressure equation which covers the range from the triple point to the critical point is also given. Author

N69-22415# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Strahlantriebe.
THEORETICAL THERMODYNAMIC DATA AND CALCULATIONS OF PERFORMANCE OF THE ROCKET PROPELLANTS SYSTEM CH SUB 4/NF SUB 3 FOR A CHAMBER PRESSURE OF 0.484 KP/CM SUP 2 [THEORETISCHE THERMODYNAMISCHE DATEN UND LEISTUNGSBERCHNUNGEN DER RAKETENTREIBSTOFFKOMBINATION CH SUB 4/NF SUB 3 FUER EINEN BRENNKAMMERDRUCK VON 0.484 KP/CM SUP 2]
W. Buschulte and H. Koch Aug. 1968 23 p refs In GERMAN; ENGLISH summary
(DLR-MITT-68-22) Avail: CFSTI

For the rocket propellant system CH_4/NF_3 and a chamber pressure of 0.484 kp/cm^2 the main theoretical thermodynamic values, the characteristic rocket propulsion figures and the vacuum specific impulse have been computed and are shown in diagrams and tables in dependence of the mixture ratio and the expansion ratio. Author (ESRO)

N69-22787# Weapons Research Establishment, Salisbury (Australia).
ONE-DIMENSIONAL HEAT CONDUCTION IN BODIES SUBJECTED TO PROLONGED CONVECTIVE HEAT TRANSFER
G. Jepps Oct. 1968 42 p refs
(WRE-HSA-24) Avail: CFSTI

Given sufficient time, the temperature in a body conducting heat in one direction only and subjected to convective heat transfer will follow a simple exponential law. This law and the time at which it becomes effective are determined. An expression for the first root of the transcendental equation occurring in this heat conduction problem is derived. Using the analysis for a flat plate, a general analysis is developed and is applied to hollow cylinders heated internally and to hollow cylinders and spheres heated externally. Temperatures are calculated for flat plates and hollow cylinders heated internally. The results agree closely with some finite-difference calculations. Author

N69-22879# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
HEAT TRANSFER IN LIQUID NITROGEN IN A ZERO-GRAVITY FIELD [TRANSMISSION DE CHALEUR DANS L'AZOTE LIQUIDE EN IMPESANTEUR
Jean-Louis Boulay (Ph.D. Thesis—Paris Univ.) 1968 56 p refs In FRENCH; ENGLISH summary
(ONERA-P-122) Avail: CFSTI

The analysis of the different boiling processes showed that there are laws of variation of the heat flux as a function of gravity

in the critical flux domain in particular. Experiments were carried out at the weightlessness laboratory where it is possible to maintain the experimental device within a gravity field of 10^{-3} to 5.10^{-5} g during 3 seconds approximately. The results obtained are compared to the values predicted by theoretical determinations.
Author

N69-22931*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VARIATION OF CONVECTIVE HEAT-TRANSFER COEFFICIENT AROUND A SIMULATED ROCKET COOLING TUBE SECTION
Ronald G. Huff Washington Apr. 1969 30 p refs
(NASA-TN-D-5168) Avail: CFSTI CSCL 20M

An experiment was performed using an insulated pipe through which hot air flowed. The pipe wall was made of tubes having a semicircular cross section which simulates the geometry found in many rocket engines. The peripheral variation of the convective heat transfer coefficient between the gas and the tubes was measured for one of the tubes. It was found that the coefficient is equal to the coefficient at the crest of the tube times the cosine of the angle measured from the crest.
Author

N69-22933*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN INVESTIGATION OF ABLATION BEHAVIOR OF AVCOAT 5026/39M OVER A WIDE RANGE OF THERMAL ENVIRONMENTS
Roger K. Crouch and Gerald D. Walberg Washington Apr. 1969 36 p refs
(NASA-TM-X-1778) Avail: CFSTI CSCL 20M

The ablation behavior of the material was found to be strongly dependent on the level of heat-transfer coefficient. At values of heat transfer coefficient less than 0.17 lbm/ft^2-sec (0.83 kg/m^2-sec), measured char recession rates were comparable to those predicted for diffusion-controlled char oxidation. At high values of heat transfer coefficient, the ablation rate increased rapidly with increasing heat transfer coefficient and severe mechanical char failure was observed. The structure, composition, and removal rate of the char were significantly influenced by stream oxygen content at low heat transfer coefficients but not at high heat transfer coefficients. Empirical correlations were found between the mass loss rate and the heat transfer coefficient and between the mass loss rate and a parameter related to the product of oxygen flow to the surface and a reference shear.
Author

N69-22984# Brookhaven National Lab., Upton, N. Y. Information Div.
STUDY OF LOCAL HEAT TRANSFER AND THERMAL FIELDS IN A SEVEN-ROD BUNDLE WITH AXIAL FLOW OF SODIUM
M. Pashak Jul. 1968 43 p refs Transl. into ENGLISH from Czechoslovakian Report UJV-1815
(BNL-TR-220; UJV-1815 Avail: CFSTI

Experimental heat transfer results were obtained for the case of a long streamlined seven-rod bundle with a lattice in the shape of a right triangle and having a density of S/D of 1.2 at lower Pe numbers. All seven rods were electrically heated in order to obtain a constant thermal flow of 31.9 kcal/m^2-hr. The investigations were carried out in the experimental area located in the sodium loop with an effective rod length of 1 to 850mm and L/d of 133. At constant temperature, the central thermal field has an L/d of 97, and, at the thermal field entrance, the field has an L/d of 18.7 at various Pe numbers. The discovered temperature variation effect around the rod bundle increases with decreasing Pe, and it was shown that this variation, taking place in the transition flow regime, is significant in the start-up of fast neutron reactors. At low sodium flow rates, the temperature differential around the fuel element is 30°C. The variation of local heat transfer coefficient and the Nu number for different regimes of fluid flow were investigated.
Author (NSA)

N69-22987*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LAMINAR HEAT-TRANSFER DISTRIBUTIONS FOR A BLUNTED-CONE, CONE-FRUSTUM REENTRY CONFIGURATION AT MACH 10
J. David Desiring Washington Apr. 1969 21 p refs
(NASA-TN-D-5148) Avail: CFSTI CSCL 20M

The aerodynamic heating characteristics of a spherically blunted cone, cone-frustum reentry configuration with a hypersonic lift–drag ratio of about 1.5 were determined at a nominal free stream Mach number of 10 and at Reynolds numbers based on free stream conditions and model length of 0.56×10^6, 1.47×10^6, and 2.67×10^6. The measured longitudinal distributions exhibit a small dip, or minimum, in the heating just aft of the blunted nose similar to that exhibited by the pressure distributions of blunted cones. On the windward ray, the heating was unaffected by Reynolds number and increased with angle of attack. The measured heat transfer distributions indicate a narrow band of locally higher heating associated with the reattachment of vortices near the leeward ray for all angles of attack greater than or equal to the forecone half angle. This phenomenon appears to be dependent upon Reynolds number as well as angle of attack. The measured base heating rate was less than 0.2 percent of the stagnation point heating rate.
Author

N69-23100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOPHYSICAL PROPERTIES OF SOME MULTILAYER INSULATIONS AT CRYOGENIC TEMPERATURES
L. B. Golovanov 2 Feb. 1968 13 p ref Transl. into ENGLISH from Russian Report JINR-237
(AD-682236; FTD-HT-23-12-68; JINR-237) Avail: CFSTI CSCL 20/13

The report discusses the development of an instrument and a procedure for measuring the heat conductivity coefficients of multilayer insulations. The instrument developed makes possible not only the determination of the value of heat conductivity coefficients, but also the evaluation of measurement error.
TAB

N69-23115# Stanford Univ., Calif. Dept. of Materials Science.
THERMODYNAMIC PROPERTIES AND DEFECT STRUCTURE OF INTERMETALLIC COMPOUNDS Progress Report, 1 May 1967–31 May 1968
David A. Stevenson Jun. 1968 33 p refs
(Contract AT(04-3)-283)
(SU-283-6) Avail: CFSTI

A progress report describing work in progress but not completed on growth and electrical and optical properties of ZnTe, self diffusion in ZnSe, and the high temperature defect structure of CdTe.
NSA

N69-23116# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ANALYSIS OF COMPLEX HEAT EXCHANGE
S. S. Filimonov et al 1968 21 p refs Transl. into ENGLISH from the book "Teploobmen, Gidravlika i Teplofizika, Sovmina Vesshchestva" Moscow, Nauka, 1968 p 107–122
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A review of analytical studies of complex heat exchange is presented, based on papers published up to 1967. The classification of the heat exchange problem into four basic groups for analysis is discussed, as well as general questions involving the

formulation of solutions. Special treatment is then given to each of the four groups: heat exchange in a moving, radiating media; heat transfer by conduction and radiation; radiative-convective heat transfer; and heat transfer by convection and heat conduction, taking into account boundary surface radiation. Conclusions reached by the review are: (1) the possibilities of theoretical solution of complex heat exchange problems of practical importance are very limited because of the slight development of general methods of solving nonlinear integral-differential or differential equations. (2) Approximate numerical methods are the fundamental approach to solving the problems at this stage, and a number of solutions have been obtained analytically by linearizing the equation, and in some cases, by iteration. (3) The obtained solutions, with a few exceptions, have not been experimentally confirmed. A.C.R.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-22213*# State Univ. of New York at Buffalo.
INCENTIVE CONTRACTING: AN ANNOTATED AND CLASSIFIED MODERN BIBLIOGRAPHY
Stanley Fong and Raymond G. Hunt Feb. 1969 38 p refs
(Grant NGR-33-015-081)
(NASA-CR-100555; TR-2) Avail: CFSTI CSCL 05A

A bibliography is given of incentive contracts and contracting phenomena ranging from the normative to the empirical. Emphasis is on work that has appeared since 1961, but some references of earlier work are included. B.G.D.

N69-22332# Brookhaven National Lab., Upton, N. Y.
ANNUAL REPORT, JULY 1, 1968
1 Jul. 1968 225 p
(Contract AT(30-2)-Gen-16)
(BNL-50106) Avail: CFSTI

The program and activities of Brookhaven National Laboratory during the fiscal year 1968 are discussed. Topics include physics, high-energy accelerators, instrumentation, chemistry, nuclear engineering, applied mathematics, biology, medical research, technical operations and services. NSA

N69-22399# Institut fur Plasmaphysik G.m.b.H., Garching (West Germany).
A DOCUMENTATION OF FUSION TECHNOLOGY
J. Mantel Oct. 1968 45 p refs
(IPP-4/56) Avail: CFSTI

The growing state of information in fusion technology has created the need for documentation in this field. This documentation covers specific problems which do not arise in documentation of physics of special fields such as plasma or vacuum physics. This is due to the fact that although fusion technology is a relatively narrow field the relevant information is spread over many thousands of periodicals or several million papers annually. The documentation reviews about 60 periodicals, 10 abstract journals and many reports. This paper analyzes the practice gained in Garching, compares documentation methods, and explains the documentation philosophy. Author (ESRO)

N69-22510*# National Aeronautics and Space Administration, Washington, D. C.
NASA SCIENCE AND TECHNOLOGY ADVISORY COMMITTEE FOR MANNED SPACE FLIGHT. WINTER STUDY ON USES OF MANNED SPACE FLIGHT, 1975–1985. VOLUME 1: PROCEEDINGS
1969 45 p Conf. held at La Jolla, Calif., 6–9 Dec. 1968
(NASA-SP-196-Vol-1) Avail: CFSTI CSCL 05A

Considered are various applications of manned space flight to scientific and technological objectives in future research. Emphasis is placed on: (1) exploration and initial colonization of the Moon; (2) exploration of Mars and other planets by manned landings; and (3) use of orbiting stations for Earth applications, astronomy, and research in the natural and life sciences. Achievement of a manned low cost transportation system and the use of a long duration manned space station develop as the most important step in the evolution of manned space flight capability. G.G.

N69-22752# Federal Council for Science and Technology, Washington, D. C. Committee on Scientific and Technical Information.
PROGRESS OF THE UNITED STATES GOVERNMENT IN SCIENTIFIC AND TECHNICAL COMMUNICATIONS, 1967
1969 106 p refs
(PB-180867) Avail: CFSTI

The highlights and accomplishments of the Office of Science and Technology/Committee on Scientific and Technical Information, COSATI panels and task groups, and other Federal agencies during 1967. Author (USGRDR)

N69-22784# System Development Corp., Santa Monica, Calif.
COVENANCE: EXPERIMENTS IN THE DEVELOPMENT OF SOCIAL ORDER Final Report
Beatrice Rome and Sydney Rome Jan. 1969 19 p
(Contract F44620-67-C-0067)
(AD-682301; SDC-TM-4175; AFOSR-69-0278TR) Avail: CFSTI CSCL 5/1

An experimental method was formulated for cultivating complex social organizations in a computer-based operant laboratory environment. These organizations were brought to progressively higher levels of performance, and the accompanying development of social order within them was observed. TAB

N69-22893# Princeton Univ., N. J.
THE DYNAMIC STABILITY OF A CONTINUOUSLY ADJUSTING COURNOT OLIGOPOLY WITH A PRODUCTION LAG
S. Peter Burley Mar. 1968 7 p refs
(PB-180853; RP-20) Avail: CFSTI

This note is intended to complement some discussions which have appeared in the literature concerning the stability of the Courtnot Oligopoly Model. Specifically, it deals with the influence of a finite time lag occurring between continuously adjusting decisions to alter output and the actual changes in output that ultimately ensue. Author (USGRDR)

N69-23089# Atomic Energy Commission, Washington, D. C. Div. of Isotopes Development.
DIVISION OF ISOTOPES DEVELOPMENT RESEARCH AND DEVELOPMENT PROJECTS, 1967 Progress Reports on Sponsored Work
Robert H. Lafferty, ed. and Joan E. Carden, ed. May 1968 284 p refs
(TID-24349) Avail: CFSTI

A short summary of objectives, results, and future plans for each research and development project sponsored by the Division is presented. The major program areas are radioisotope production, thermal applications, environmental and ocean sciences, radiation analysis and control, radiopreservation of foods, process radiation, and radiation engineering. NSA

N69-23170# California Univ., Livermore. Lawrence Radiation Lab.
INTERMEDIATE RANGE GROUND MOTIONS FOR PRE-GONDOLA 2 AND ASSOCIATED EVENTS
Dean V. Power Apr. 1968 76 p refs
(PNE-1115; UCRL-50433) Avail: CFSTI

Ground motion records from seven high explosive cratering events in northeastern Montana were analyzed for peak velocity, power spectral density, and velocity spectra. The events included four 20-ton single charges at depths of burst which varied from 42 to 57 ft, a 140-ton row charge consisting of three 20-ton charges and two 40-ton charges at optimum depths of burst, and a fully coupled charge of 0.5 tons and a decoupled charge of 0.5 tons at optimum depths of burst. It was found that at these depths and charge weights an increase in depth of burst resulted in an increase in peak velocities and power spectral densities as measured at distant points (>5 km), while no significant frequency shifts were noted. Power spectral density was found to be approximately proportional to the first power of yield. An increase in both velocities and power spectral densities for small decoupling factors was found to occur for a certain explosive-cavity configuration. Author (NSA)

N69-23231 Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
CONTAINERIZATION
Doug Schweitzer Jan. 1969 165 p refs
(Grant DRB G-9772-04) Avail: CFSTI

An attempt has been made to describe and illustrate the various components of container systems presently in operation in the transportation industry. Speculation is made on future containers and vehicles. Advantages and disadvantages of containerization are examined and compared. Several suggestions regarding potential applications of the concept are made. Author

N69-23339# Istituto Superiore di Sanita, Rome (Italy). Lab. di Fisica.
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD MAY TO AUGUST 1968 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE MAGGIO-AGOSTO 1968]
17 Oct. 1968 24 p refs In ITALIAN; ENGLISH summary
(ISS-68/36) Avail: CFSTI

A synopsis is presented on various lectures pertaining to superfluidity, hydrogen bond dynamics in ferroelectric crystals, Mossbauer spectroscopy of dilute paramagnets such as haemoproteins, stellar evolution and neutron stars, 10 GeV synchrotron design philosophy, electron diffusion, and nuclear interaction of low energy photons. Author

N69-23347# Oak Ridge National Lab., Tenn.
METALS AND CERAMICS DIVISION Annual Progress Report for Period Ending 30 Jun. 1968
Sigfred Peterson, ed Oct. 1968 276 p refs
(Contract W-7405-ENG-26)
(ORNL-4370) Avail: CFSTI

Fundamental programs include studies on crystal physics, metal deformation and annealing, deformation of crystalline solids, diffusion in solids, electron microscopy, electronic properties of metals and alloys, ceramics, physical property data, ionic media spectroscopy, superconducting materials, metal surface reactions, theoretical calculations, and X-ray diffraction. High temperature materials research covers work in general physical and mechanical metallurgy, tungsten metallurgy, alkali metal corrosion of high temperature materials, nitride fuels development, and materials development for isotopic power sources. Studies on general fuels and materials include fuel element fabrication development, irradiation damage to aluminum, mechanical properties research, nondestructive test development, sintered aluminum products development, sol-gel fast reactor fuels, joining effects on nuclear materials, and zirconium metallurgy. Reactor development support is comprised of assistance in research reactor core procurement, a gas cooled reactor program, heavy section steel technology, high flux isotope reactor materials and target development, cladding materials for SNAP 8, molten salt reactor program, reactor evaluation, terrestrial low power reactor research, and thorium utilization. Work in metallography, Rover rocket materials, dispersion strengthening of aluminum base alloys, and assistance for the Army pulsed radiation facility reactor are also included. P.A.B.

Collections of NASA Documents

NASA deposits its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers. Each center, located in one of the organizations listed below, is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

California: University of California, Berkeley
Colorado: University of Colorado, Boulder
District of Columbia: Library of Congress
Georgia: Georgia Institute of Technology, Atlanta
Illinois: The John Crerar Library, Chicago
Massachusetts: Massachusetts Institute of Technology, Cambridge
Missouri: Linda Hall Library, Kansas City
New York: Columbia University, New York
Pennsylvania: Carnegie Library of Pittsburgh
Texas: Southern Methodist University, Dallas
Washington: University of Washington, Seattle

NASA publications are currently being forwarded to the public libraries in the cities listed below:

California: Los Angeles and San Diego
Colorado: Denver
Connecticut: Hartford
Massachusetts: Boston
Michigan: Detroit
Minnesota: St. Paul and Minneapolis
Missouri: Kansas City and St. Louis
New Jersey: Trenton
New York: Brooklyn, Buffalo, Rochester, and New York
Ohio: Cleveland, Cincinnati, Dayton, Toledo, and Akron
Oklahoma: Oklahoma City
Tennessee: Memphis
Texas: Fort Worth and Dallas
Washington: Seattle
Wisconsin: Milwaukee

In addition, NASA regularly sends its publications to the Enoch Pratt Free Library in Baltimore, Maryland, and the Wilmington Institute Free Library, Wilmington, Delaware.

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York 10017.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546
OFFICIAL BUSINESS

FIRST CLASS MAIL

POSTAGE AND FEES PA
NATIONAL AERONAUTICS
SPACE ADMINISTRATIO

POSTMASTER: If Undeliverable (Section
Postal Manual) Do Not

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

— NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports, and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546